INSTRUCTION MANUAL

Serial Number ____________

TYPE 556 OSCILLOSCOPE

Tektronix, Inc.

S.W. Millikan Way ● P. O. Box 500 ● Beaverton, Oregon 97005 ● Phone 644-0161 ● Cables: Tektronix

070-0757-00 1167

WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial or Model Number with all requests for parts or service.

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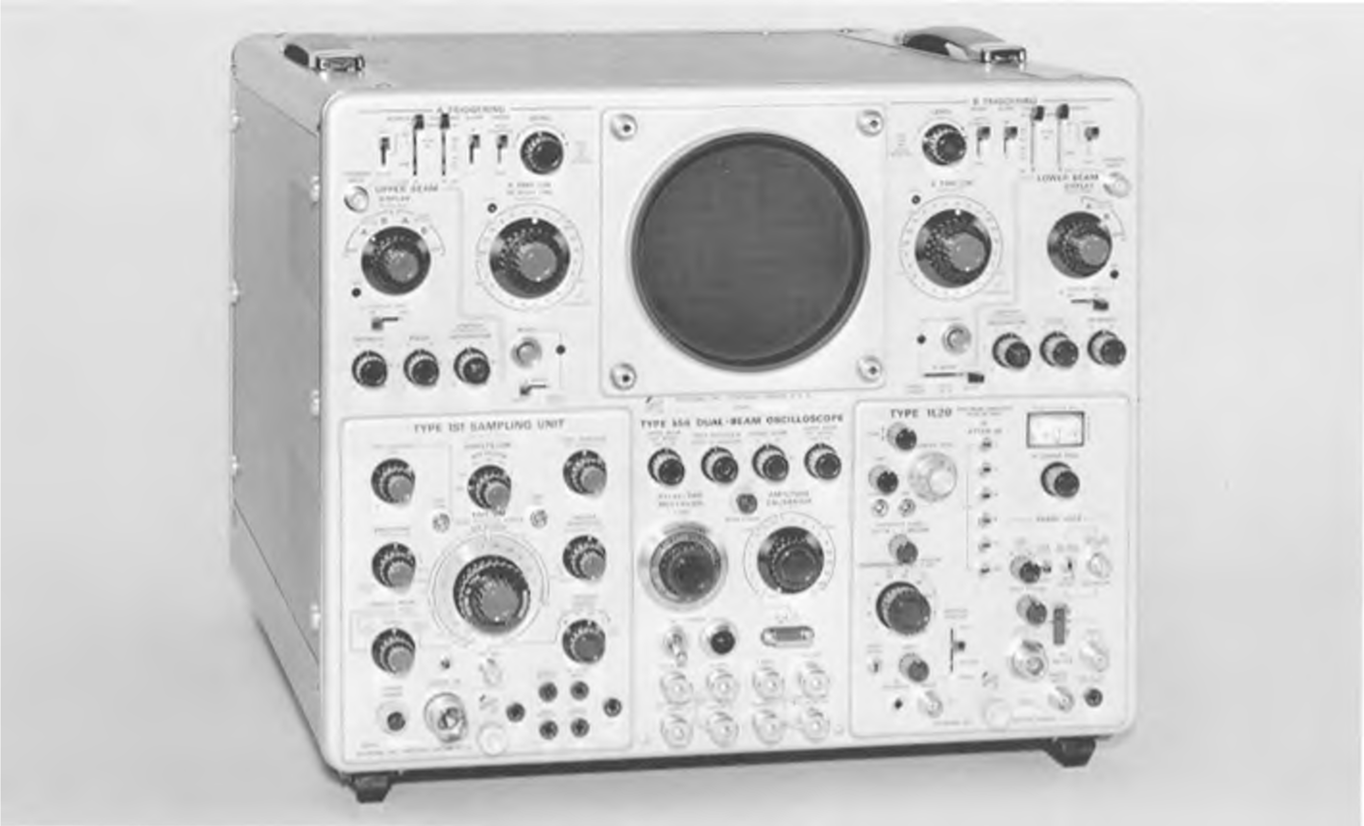
CONTENTS

Abbreviations and symbols used in this manual are based on or taken directly from IEEE Standard 260 "Standard Symbols for Units", MIL-STD-12B and other standards of the electronics industry. Change information, if any, is located at the rear of this manual.



Serial number 2000 and up.

Serial number 1999 and below.

Fig. 1-1. Type 556 Oscilloscopes.

SECTION 1
CHARACTERISTICS

Change information, if any, affecting this section is found at the rear of the manual.

Introduction

The Type 556 Oscilloscope—is a versatile dual-beam laboratory type instrument providing accurate voltage and time measurements in the DC to 50 MHz frequency range. Two complete horizontal and vertical deflection systems permit completely indepentent operation of the two beams.

The Upper Beam can display the signal from either the left or right vertical plug-in unit and may be controlled by either the A or B time base or an external signal. The Lower Beam displays the signal from the right plug-in and the sweep is controlled by the B time base or an external signal. The left and right plug-in compartments accept all letter series and 1-series plug-ins.

Special circuits within the oscilloscope provide selection of an accurate, continuously-variable delay when using the B sweep. The B sweep may be delayed by the A sweep from 0.1 μs to 50 s (calibrated) after application of a trigger pulse. This feature permits the delayed B sweep to expand a selected portion of the undelayed A sweep, thereby providing precise time measurements and detailed observation of the signal. Both the delayed and undelayed sweeps can be presented simultaneously on the oscilloscope screen. The Upper Beam trace has an intensified zone indicating the portion of the signal being displayed by the B sweep and Lower Beam.

The instrument is designed to operate over an ambient temperature range of 0° C to +50° C. Performance specifications that are given in the center column apply over this temperature range after a warmup time of 20 minutes. Supplemental information describing a characteristic or a feature is also incldded in this portion of the manual.

VERTICAL AMPLIFIERS

Characteristics	Performance Specification	Supplemental Information
Frequency Response	DC to ≥50 MHz at 3 dB down with a 1-series plug-in unit having a risetime of 3.12 ns or less.	
Risetime		≤6.25 ns. Indicated risetime of 6.93 ns with a Test Load Plug-In Unit (Tektronix Part No. 067-0521-00) having a risetime of 3 ns.
Transient Response on Screen	≤2.25% peak overshoot, rounding, ringing or tilt.	Applies to all three vertical modes with Test Load Plug-In Units.
Gain Change with Line Voltage Change	≤1% from 147 VAC peak to 178 VAC peak.	
Trace Drift with Line Voltage Change	±2 mm from 147 VAC peak to 178 VAC peak.	

A & B SWEEP GENERATORS

Calibration Accuracy 5 s/cm to 0.1 μs/cm	±3% of displayed time between two points displayed within the middle 8 cm.	
×10 Magnified Display	±5% of displayed time between any two points ≥1 cm apart displayed within the middle 8 cm.	Calibrated from 4 cm to 70 cm from sweep start. Extends fastest sweep rate to 10 ns/cm.
Variable Time/Cm Range	≥2.5:1.	Extends slowest sweep to approximately 12.5 s/cm.
Sweep Length	10.5 cm ±0.5 cm	At 1 ms/cm.

VARIABLE TIME DELAY

Delay Time Accuracy 5 s/cm to 1 μs/cm	±1% of indicated delay time ±2% of A TIME/CM setting + fixed delay of ≤150 ns in system.	1% of A TIME/CM setting corresponds to 1 minor division on the DELAY-TIME MULTIPLIER dial.
0.5 μs/cm to 0.1 μs/cm	±1% of indicated delay time ±5% of A TIME/CM setting + fixed delay of ≤150 ns in system.	For additional information refer to Fig. 2-10 in the Operation Instructions.

Characteristics	Performance Specification	Supplemental Information
Incremental Delay Time Accuracy 5 s/cm to 1 μs/cm	±1% of indicated incremental delay time ±4% of A TIME/CM setting.	Incremental Delay Time is the difference between two delay time readings.
0.5 μs/cm to 0.1 μs/cm	±1% of indicated incremental delay time ±7% of A TIME/CM setting.	For additional information refer to Page 2-24 in the Operating Instructions.
Short Term Jitter	≤1 part in 20,000 of the available delay time.	

EXTERNAL HORIZONTAL AMPLIFIERS

Ext. Horizontal Deflection Factor	≤0.1 V/cm with DISPLAY MAG in ×10 position.	
Transient Response	±3% peak overshoot, rounding, ringing or tilt.	
Variable Range	≥10:1	
Frequency Response	DC to ≥400 kHz at 3 dB down. VARIABLE control set fully cw.	
Maximum Input Voltage	50 V combined DC + peak AC.	With DISPLAY MAG in ×10 position.
Input C		Approximately 65 pF.

A & B TRIGGERING FEATURES

Characteristic	Feature
Source	Internal Normal (from left or right trigger pick-off circuit within the vertical amplifier), Internal Plug-In (from one of the channels in the left or right Type 1A1 or 1A2 Plug-In Unit), Line and External.
Coupling	Capacitive (AC), low-frequency reject (AC LF REJ), high-frequency reject (AC HF REJ) or direct (DC).
Slope	Triggering on positive-or-negative-going portion of triggering signal.
Mode: Auto Stability	Free runs sweep in absence of a triggering signal; instrument can be triggered on signals ≥30 Hz.
Triggered	Triggered at an adjustable level.
Jitter	≤2 ns.
LEVEL Control Range: Normal	≥ ±2 V.
×10 Increase	≥ ±20 V.
External Trigger Input: R & C	Approximately 1 megohm paralleled by approximately 35 pF.
Volts	50 V maximum (DC plus peak AC).

A & B TRIGGERING SENSITIVITY

Trigger Coupling/Source		To 10 MHz	To 50 MHz
AC: INT NORM		≤ 2 mm display amplitude above 60 Hz.	≤ 1 cm display amplitude.
EXT		≤ 0.2 V above 60 Hz.	≤ 0.4 V.
AC LF REJ: INT NORM	≥ 3 cm display amplitude at 30 Hz.	≤ 2 mm display amplitude above 2.5 kHz.	≤ 1 cm display amplitude.
EXT	≥ 3 V at 30 Hz.	≤ 0.2 V above 2.5 kHz.	≤ 0.4 V.
AC HF REJ: INT NORM	≤2 mm display amplitude from 60 Hz to 60 kHz, ≥1 cm at 6 MHz.		
EXT	≤0.2 V from 60 Hz to 60 kHz, ≥1 V at 6 MHz.		
DC INT NORM		≤ 3.5 mm display amplitude.	≤ 2 cm display amplitude.
EXT		≤ 0.2 V.	≤ 0.4 V.
INT PLUG IN	Characteristics that apply for the EXT trigger input also apply to the Int Plug-In interconnection (pin 5 of plug-in connectors J11 and J12).		

AMPLITUDE CALIBRATOR

Characteristic	Performance Specification	Supplemental Information
Voltage Accuracy	$\pm 2\%$.	
5 mA Current Loop Accuracy	$\pm 2\%$.	
Repetition Rate	1 kHz $\pm 25\%$	
Duty Cycle	45% to 55%.	
Risetime	$\leq$ 1.5 μs.	70 pF load.
Terminated Voltage Accuracy	One-half indicated voltage $\pm 2\%$ when terminated into 50 ohms $\pm 0.1\%$.	Applies to AMPLITUDE CALIBRATOR switch positions from 0.2 mV to 0.2 V only.

Z AXIS INPUTS

Sensitivity		10 V P to P causes noticeable modulation intensity.
Input R at DC		1 megohm $\pm 10\%$.

FRONT-PANEL OUTPUT SIGNALS

A GATE	$\geq$ 8 V positive-going pulse.	With baseline at zero volts. Time coincident with the A sweep. Maximum current is 10 mA. Recommended load resistance $\geq$1 kΩ.
B GATE	$\geq$ 8 V positive-going pulse.	With baseline at zero volts. Time coincident with the B sweep. Maximum current is 10 mA. Recommended load resistance $\geq$1 kΩ.
DLY'D TRIG	$\geq$ 7 V positive-going pulse into a $\geq$1 kΩ load.	Pulse occurs at the end of the A sweep delay period.
A SAWTOOTH	$\geq$ 9 V/cm.	Has the same time duration as the A sweep. Recommended load resistance $\geq$30 kΩ.
B SAWTOOTH	$\geq$ 9 V/cm.	Has the same time duration as the B sweep. Recommended load resistance $\geq$30 kΩ.
Line Frequency	50 Hz to 60 Hz	400 Hz with special fan modification.
Power Consumption		$\approx$840 W maximum. $\approx$1 kVA maximum.
Thermal Protection		An automatic resetting thermal cutout interrupts instrument power if internal temperature exceeds safe operating level.

POWER SOURCE REQUIREMENTS

For serial numbers 2000 and up			
Regulating Range Selection:	AC RMS Operating Range ($\leq$2% harmonic distortion of the input power waveform)	AC Peak Operating Range ($>$2% harmonic distortion[1])	A Line Voltage Selector assembly facilities selection of a regulating range compatible with the actual line voltage.
115 Volts			
LO	90 to 110 V	127 to 156 V	
M	104 to 126 V	147 to 178 V	
HI	112 to 136 V	158 to 192 V	
230 Volts			
LO	180 to 220 V	254 to 311 V	
M	208 to 252 V	294 to 356 V	
HI	224 to 272 V	316 to 384 V	

[1]**Crest Factor** $= \frac{\text{Peak V}}{\text{RMS V}} =$ **between 1.30 and 1.414.**

Characteristic	Performance Specification		Supplemental Infromation
For serial numbers 100-1999			
Normal Line:	AC RMS Operating Range ($\leq$2% harmonic distortion of the input power waveform)	AC Peak Operating Range (>2% harmonic distortion[1])	
115 VAC Nominal	100 to 130 V	142 to 183 V	Normally wired at the factory for this voltage unless directed otherwise.
230 VAC Nominal	200 to 260 V	284 to 366 V	
Low Line: 104 VAC Nominal	90 to 117 V	127 to 165 V	
208 VAC Nominal	180 to 234 V	254 to 330 V	

CRT AND DISPLAY

Characteristic	Information
Tube Type	T5560-31-1. Dual-Beam, round, glass envelope. Tektronix Part No. 154-0500-00.
Phosphor	P31 standard. Others available on special order.
Accelerating Potential	Approximately 10 kV; gun potential is 2 kV.
Scan Area	$\geq$6 cm vertical by 10 cm horizontal per beam. Beams can be overlapped in a 4 cm area.
Graticule Type	Internal. 8 cm vertical by 10 cm horizontal. Each major division is 1 cm; four corners are omitted.
Graticule Illumination	Variable edge lighting.
Internal Unblanking	DC-coupled to CRT control grids from the Sweep Generators.
Orthogonality	Within $\pm$1%.
Trace Rotation Range	Sufficient to align traces with their respective graticule lines.
Beam Finder	Limits traces within graticule area.

ELECTROMAGNETIC INTERFERENCE

Electromagnetic Interference	Meets interference specifications of MIL-I-6181D over the following frequency ranges: Radiated (with CRT mesh filter, cabinet covers and BNC connector covers installed)—150 kHz to 1 GHz; conducted (power line)—150 kHz to 25 MHz.

MECHANICAL CHARACTERISTICS

Construction	Aluminum alloy chassis, panel and cabinet. Glass laminate etched circuit boards.
Finish	Anodized front panel. Blue vinyl-finished cabinet and rear panel.
Overall Dimensions:	Measured at maximum points; 15 inches high, 16-7/8 inches wide, 24 inches deep.

[2]**Crest Factor** $= \frac{\text{Peak V}}{\text{RMS V}} =$ **between 1.30 and 1.414.**

ENVIRONMENTAL CHARACTERISTICS

The Type 556 has been designed to operate over a temperature range of 0° C to +50° C, altitude up to 15,000 feet. The non-operating storage temperature range is —40° C to +65° C, altitude up to 50,000 feet. After storage at either extreme, the instrument must be allowed at least 4 hours time for all components to return to the ambient temperature range 0° C to +50° C before operating.

Further information on environmental test procedures may be obtained by contacting your local Tektronix Field Office or representative.

ACCESSORIES

Standard accessories supplied with the Type 556 can be found on the last pullo-ut page of the Mechanical Parts List Illustrations. For optional accessories see the Tektronix, Inc. catalog.

SECTION 2
OPERATING INSTRUCTIONS

Change information, if any, affecting this section will be found at the rear of the manual.

General

This section of the manual provides for the effective use of the instrument by describing the function and operation of the front panel controls and connectors, listing the first time and general operating instructions and presenting some basic applications.

Nomenclature and Terminology

For reference and guidance, these terms are defined as they are used in this manual.

Alternate Mode—A time-sharing method of displaying the output signals of two or more channels with a single cathode ray tube beam. Channel switching is sequential and occurs at the end of the sweep.

Chopped Mode—A time-sharing method of displaying output signals of two or more channels with a single cathode ray tube beam, in sequence, at a rate not referenced to the sweep.

Chopping Rate—The rate at which channel switching occurs in Chopped Mode.

Chopping Transient Blanking—The process of blanking the indicating spot during the switching periods in Chopped Mode.

Dual-Beam Oscilloscope—An oscilloscope in which the cathode ray tube produces two separate electron beams that may be individually or jointly controlled.

Dual-Trace—A mode of operation in which a single beam in a cathode ray tube is shared by two signal channels.

Multi-Trace—A mode of operation in which a single beam in a cathode ray tube is shared by two or more signal channels.

Signal Channel—A signal amplifying circuit in a plug-in unit. With dual and multi-channel plug-ins, the channels are generally designated Channel 1 (or A) Channel 2 (B), etc.

Power Requirements

This instrument may be operated with power from either a 115-volt or a 230-volt (nominal) power source. With proper positioning of the Line Voltage Selector connectors, the power supply circuit will provide correct DC voltages with adequate regulations with any line voltage within voltage limits of 90 to 136 volts RMS and 180 to 272 volts RMS and frequency limits of 50 to 60 Hz. The adjustable turns ratio design of the power transformer provides the means of making the instrument compatible with this wide range of power source voltages.

SN 2000-up

A Line Voltage selector assembly is provided to facilitate changing the power transformer turns ratio (see Fig. 2-1). The assembly contains two line fuses and two movable pins and socket type connectors. The two-position connector is termed the Voltage Selector and the three-position connector is termed the Range Selector.

Table 2-1 lists the six Voltages and Range selector combinations and the line voltage ranges they should be used with. Before connecting the instrument to a power source, measure the power source line voltage and position the Voltage and Range selectors accordingly.

TABLE 2-1

Voltage Selector position	Range Selector position	Will provide optimum regulation for line voltages from
115 V	LO	90 to 110 volts
115 V	M	104 to 126 volts
115 V	HI	112 to 136 volts
230 V	LO	180 to 220 volts
230 V	M	208 to 252 volts
230 V	HI	224 to 272 volts

To change the power transformer from one regulating range configuration to another use the following procedure:

1. Disconnect the instrument from the power source.

2. Loosen the two captive screws and remove the cover. Since the line fuses are attached to the cover, they will be pulled from their holders with the cover.

3. To change nominal line selections, pull the Voltage Selector until its pins are free of the sockets, invert the selector and reseat the pins in the desired sockets.

NOTE

115-volt to 230-volt plug adapters are not supplied with this instrument. If a suitable adapter is not available, it may be necessary to change the line-cord plug.

4. To change regulating range selections, pull the Range selector until its pins are free of the sockets, move it to the desired range position and seat the pin in the sockets.

5. Replace the assembly cover and the two line fuses. Press the cover firmly onto the assembly to seat the two fuses in their holders, then tighten the captive screws.

6. The indicating tabs on the selectors will be protruding through the covers to indicate the selected regulating range. Always check the position of these tabs before applying power to the instrument.

SN 100-1999

Instruments with serial numbers 100-1999, unless tagged otherwise, are connected at the factory for operation at 115 volts (nominal). The power transformer has eight primary terminals which are connected to solderless pin connectors on the Power board. These quick-change connectors make possible operation from four different nominal AC voltages: 104, 115, 208 and 230 V, 50 to 60 Hz. Fig. 2-2 illustrates the jumper and lead connections required for operation on each of the stated line voltages. For 208 V and 230 V operation, the two unused jumpers can be stored on the unused pins of terminals J and T. All lead connections to the board that are not shown in Fig. 2-2 remain as they are.

No change in fan connections is required when changing the connection on the board as directed in the illustration.

NOTE

Two metal tags (printed on each side) are provided at the rear of the instrument to indicate the four nominal line voltages. If the primary wiring is changed, be sure to use the proper tag to indicate the voltage for which the instrument is wired.

Temperature considerations

To reduce operating temperatures, air is drawn in through the filter at the rear and blown forward through the instrument. For the most efficient air circulation and heat dissipation, provide at least three inches clearance at the rear, two inches at the sides and operate the instrument with the side covers installed. If the fan becomes inoperative or the air circulation is obstructed, the internal temperatures will exceed a safe operating level in a relatively short period of time. To prevent damage to the components from excessive temperatures, a thermal cutout switch is incorporated in the power supply circuitry. This switch is designed to interrupt power to the instrument when the ambient temperature exceeds about 140° F.

CAUTION

Since the thermal cutout switch will reset when its ambient temperature decreases to some level below its actuating temperature, set the POWER switch to OFF before attempting to remedy the cause of the high temperature condition.

CONTROLS AND CONNECTORS

Figure 2-3 shows the location of all the instrument operating controls and connectors. A brief description of each type of control and connector is given in the following table. Controls with the same nomenclatures generally perform identical functions for their respective beams and a description for one is applicable to the other. Those controls with the same nomenclature, but with differences in their functions, are pointed out and described as separate type controls.

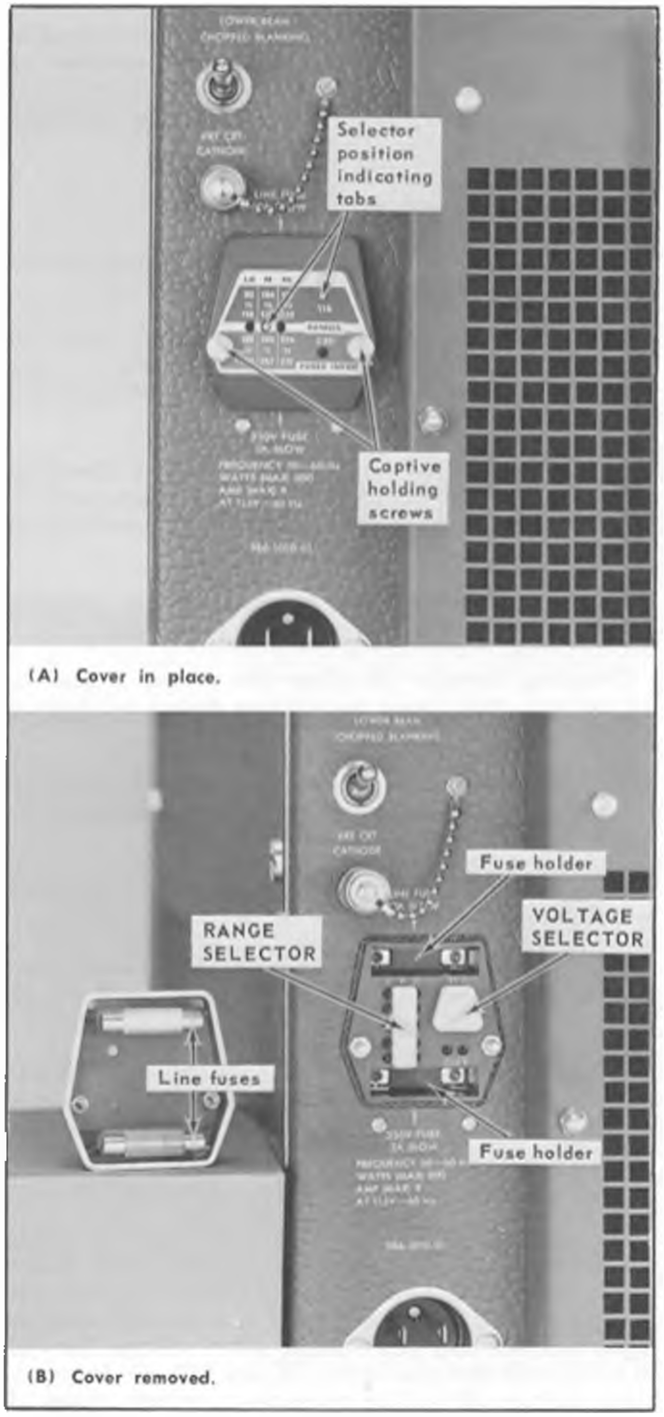
Some of the controls and connectors, particularly those with complex functions or multiple applications, are described in greater detail under General Operating Instructions.

A AND B TRIGGERING CONTROLS

Source — Selects triggering signal source, Two selector switches are combined under the nomenclature of SOURCE to provide this complex switching function. The selections of the two position selector switch are:

LEFT: From left plug-in or left vertical amplifier.

RIGHT: From right plug-in or right vertical amplifier. The selections of the four position selector switch are:



(A) Cover in place.

(B) Cover removed.

Fig. 2-1. Line Voltage Selector assembly; provided in instruments with serial number 2000 and up.

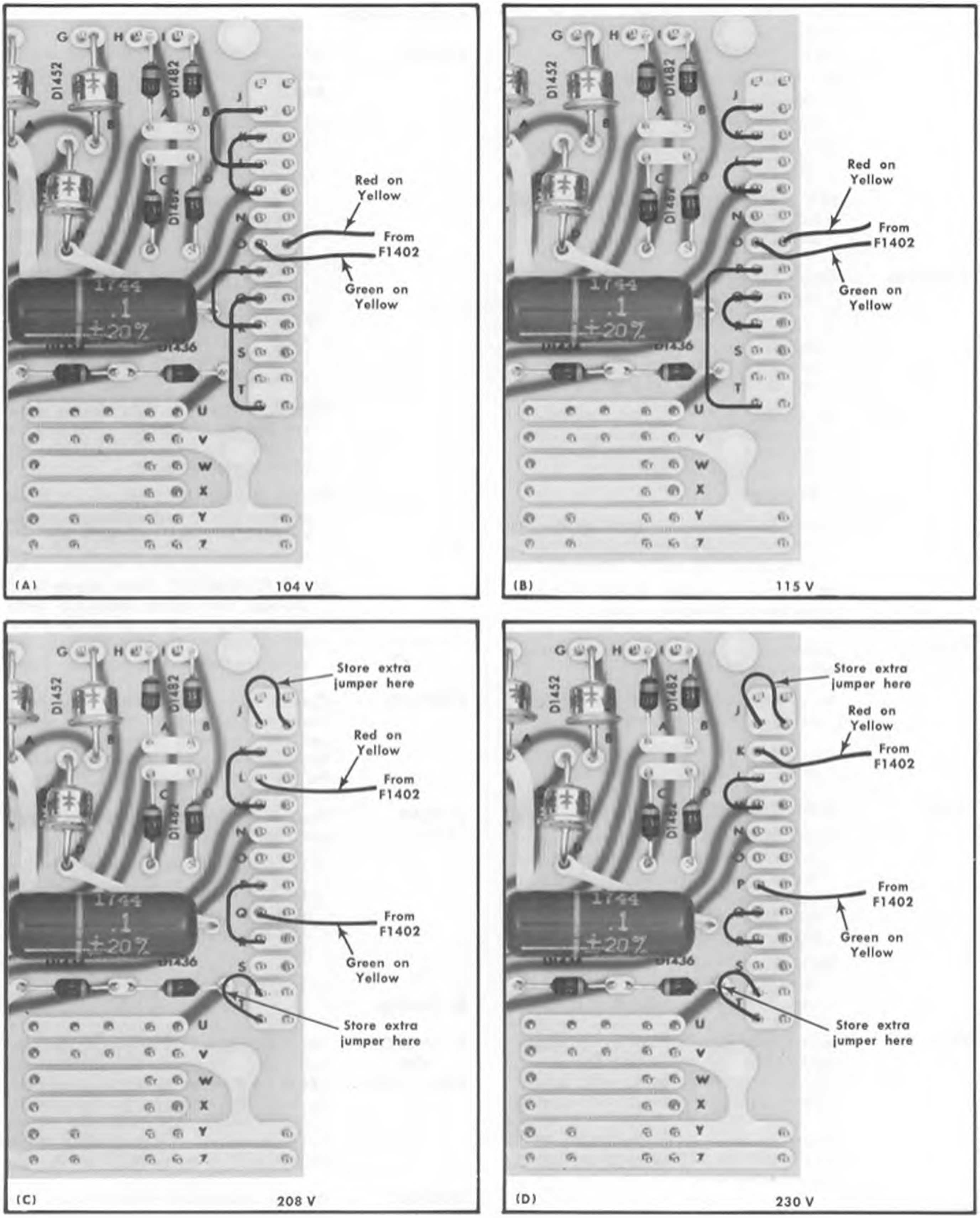


Fig. 2-2. Positions of the movable jumper wires (black on yellow) for the four nominal line voltage selections. This illustration is applicable to 556 SN's 100 to 1999.

INT NORM: From trigger pickoff in the oscilloscope vertical amplifier for the respective plug-in unit.

INT PLUG IN: From trigger pickoff in the respective plug-in unit. Applies to multi-trace plug-in units with this capability.

LINE: Uses a line-frequency signal as a trigger.

EXT: From signal applied to the TRIGGER INPUT connector. Not affected by LEFT-RIGHT switch.

COUPLING Determines method of coupling the triggering signal to the trigger circuit.

AC: Blocks the DC component and allows triggering to take place on the AC component. With frequencies about 30 Hz and below, use the DC position.

AC LF REJ: Rejects DC and progressively attenuates signal frequencies below about 2.5 kHz, allowing the trigger circuits to respond only to the higher frequencies.

AC HF REJ: Rejects DC, passes signals between 60 Hz and 60 kHz and progressively attenuates signals above 60 kHz.

DC: Permits triggering on both high and low (to DC) frequency signals.

SLOPE Selects portion of triggering signal which will trigger the sweep.

+: Sweep triggers from positive-going portion of the triggering signal.

—: Sweep triggers from negative-going portion of the triggering signal.

MODE Selects triggering mode.

AUTO STABILITY: Permits normal triggering on signals with repetition rates higher than about 30 Hz. With no trigger signal or with a lower repetition rate, the time-base circuit free runs and provides a convenient reference trace.

TRIG: Permits normal triggering on all triggering signals. No trace occurs when the triggering signal is removed.

LEVEL Selects the amplitude point on the triggering signal where sweep triggering occurs. When the knob is pulled out, greater triggering range is offered for triggering on higher amplitude signals. The sweep trigger circuit is most sensitive to small signals with the LEVEL control pushed in and set close to 0.

TRIGGER INPUT Connector for applying an external trigger signal to the Sweep Trigger circuit when its SOURCE switch is set to EXT.

Upper Beam

DISPLAY Selects vertical (Y-axis) and horizontal (X-axis) mode of operation for the **Upper Beam.**

LEFT PLUG-IN EXT: Left plug-in signal provides the vertical deflection while the signal applied to the UPPER BEAM EXT HORIZ IN connector provides the horizontal deflection.

LEFT PLUG-IN A: Left plug-in signal provides the vertical deflection and the A TIME/CM switch sets the sweep rate of the Upper Beam.

LEFT PLUG-IN B: Left plug-in signal provides the vertical deflection and the B TIME/CM switch sets the sweep rate of the Upper Beam.

RIGHT PLUG-IN A: Right plug-in signal provides the vertical deflection and the A TIME/CM switch sets the sweep rate of the Upper Beam.

RIGHT PLUG-IN B: Right plug-in signal provides the vertical deflection and the B TIME/CM switch sets the sweep rate of the Upper Beam.

RIGHT PLUG-IN EXT: Right plug-in signal provides the vertical deflection while the signal applied to the UPPER BEAM EXT HORIZ IN connector provides the horizontal deflection of the Upper Beam.

POSITION Controls horizontal position of Upper Beam trace. Single knob controls both coarse and fine adjustment of the beam position by means of a backlash coupling between the two sections of the control.

DISPLAY MAG Expands the Upper Beam display to left and right of graticule center.

×1: Normal presentation of the display.

×10: Horizontal length of Upper Beam display is magnified by 10. The ×10 light indicates that the display is magnified.

A Sweep

A TIME/CM OR DELAY TIME Normally referred to as the A TIME/CM switch in this manual. Selects the sweep rate of the A sweep generator. Also selects the basic delay time (to be multiplied by the DELAY-TIME MULTIPLIER dial setting) for delaying the B sweep when the B MODE switch is set to DLY'D BY A.

VARIABLE Provides continuously variable sweep rate to at least 2.5 times the setting of the A TIME/CM switch. Sweep rate is calibrated when the control is set fully clockwise to

CALIBRATED. An UNCAL neon turns on when the VARIABLE control is not in the CALIBRATED position.

RESET When the RESET lamp is on, the A sweep is ready to start when a trigger is received (A MODE switch set to SINGLE SWEEP). After a sweep is completed, the RESET button must be pressed before another sweep can be presented.

A MODE Determines the A sweep generator operating mode.

NORM: The A sweep is triggered from an internal or external signal as selected by the A TRIGGERING controls.

SINGLE SWEEP: The A sweep generator generates one sweep and then shuts off until reset.

B Sweep

B TIME/CM Selects the sweep rate of the B sweep generator. Can be used to drive the Upper Beam, Lower Beam, or both beams, depending on the position of the DISPLAY switches.

VARIABLE and RESET Performs same functions for B sweep as corresponding control and pushbutton do for A sweep.

B MODE Determines the B sweep generator operating mode.

SINGLE SWEEP: The B sweep generator generates one sweep and then shuts off until reset.

DLY'D BY A: B sweep circuit will not produce a sweep until a trigger pulse is received following the delay time selected by the A TIME/CM (OR DELAY TIME) switch and the DELAY-TIME MULTIPLIER dial.

NORM: The B sweep is triggered from an internal or external signal as selected by the B TRIGGERING controls.

Lower Beam

DISPLAY Selects horizontal (X-axis) mode of operation for the **Lower Beam.**

RIGHT PLUG-IN: Right plug-in signal provides the vertical deflection and the A TIME/CM switch sets the sweep rate of the lower beam (not incorporated in instruments serial numbered 100-1999).

RIGHT PLUG-IN B: Right plug-in signal provides the vertical deflection and the B TIME/CM switch sets the sweep rate of the Lower Beam.

RIGHT PLUG-IN EXT: Right plug-in signal provides the vertical deflection while the signal applied to the LOWER BEAM EXT HORIZ IN connector provides the horizontal deflection of the Lower Beam.

POSITION and DISPLAY MAG Performs same functions for Lower Beam as corresponding controls do for Upper Beam.

Upper Beam and Lower Beam (for both beams where applicable)

INTENSITY Controls brightness of the display.

CAUTION

Excessive intensity can permanently damage the phosphor on the CRT screen. Use the INTENSITY control to keep the beam brightness turned down below the level that causes a halo to form around the CRT spot or trace.

FOCUS Provides adjustment for a well-defined display. Used in conjunction with the INTENSITY and ASTIGMATISM controls.

CONTRAST (For Ppper Beam only in instruments SN 100-1999). Controls brightness of non-intensified portion of trace or display during delayed B sweep mode of operation.

ASTIGMATISM Used in conjunction with the INTENSITY and FOCUS controls for obtaining a well-defined display.

Lower Portion of Front Panel

UPPER BEAM EXT HORIZ VAR Controls amount of Upper Beam horizontal deflection produced by voltage applied to the UPPER BEAM EXT HORIZ IN connector. Horizontal deflection factor is continuously variable from about 1 to 10 V/cm with the Upper Beam DISPLAY switch set to either of the EXT positions and the DISPLAY MAG switch set to ×1; from 0.1 to about 1 V/cm when DISPLAY MAG switch is set to ×10.

TRACE ROTATION Screwdriver adjustment to simultaneously align the traces of both beams with their respective horizontal center lines.

TRACE SEPARATION Varies the vertical position of the Upper Beam with respect to the Lower Beam when the Upper Beam DISPLAY switch is set to any of the RIGHT PLUG-IN positions.

SCALE ILLUM Controls graticule illumination.

LOWER BEAM EXT HORIZ VAR Same function as corresponding Upper Beam control but applied to the Lower Beam horizontal deflection.

DELAY-TIME MULTIPLIER Works in conjunction with the A TIME/CM (OR DELAY TIME) switch. Provides variable delay of the B sweep up to 10.00 times the delay time indicated by the A TIME/CM switch.

BEAM FINDER Returns the displays of both beams to the screen when the button is pressed. Limits the horizontal and vertical amplifier dynamic ranges of both beams. Used to locate trace(s) which exceeds scan of display area.

AMPLITUDE CALIBRATOR Determines the peak-to-peak positive-from-ground voltage available at the CAL OUT connector.

NOTE

When working into an external 50-ohm load using the .2 VOLTS to 200 mVOLTS positions, output amplitude is one-half the indicated voltage.

5 mA Current Loop Provides 5 mA square-wave current from the calibrator circuit. The arrow shows direction of conventional current flow (i.e., positive to negative).

POWER Toggle switch: Applies line power to the low-voltage power transformer.

Light: Indicates that the AC line voltage is applied to the power transformer.

DLY'D TRIG Output connector which supplies a sharp positive-going trigger spike equal to or greater than 7 V at the end of the delay period as set by the A TIME/CM (OR DELAY TIME) switch and the DELAY-TIME MULTIPLIER control.

A GATE Output connector which supplies a positive-going square-wave pulse equal to or greater than 8 V coincident with the A sweep. Pulse duration is approximately 10.5 × the setting of the A TIME/CM switch when the (A) VARIABLE control is set to CALIBRATED.

B GATE Same as A GATE except applies to B TIME/CM switch and (B) VARIABLE control.

CAL OUT Output connector for the Amplitude Calibrator.

UPPER BEAM EXT HORIZ IN Input connector for applying an external horizontal signal to the Upper Beam horizontal amplifier when the Upper Beam DISPLAY switch is set to either EXT position. A positive voltage deflects the beam from left to right.

A SAWTOOTH Output connector which supplies a sawtooth voltage from the A sweep generator. Peak amplitude is equal to or greater than 9 V/cm. The sawtooth ramp is positive-going from near ground.

B SAWTOOTH Same as A SAWTOOTH except applies to the B sweep generator output.

LOWER BEAM EXT HORIZ IN Same as UPPER BEAM EXT HORIZ IN except applies to the Lower Beam horizontal amplifier when the Lower Beam DISPLAY switch is set to EXT.

Rear Panel (Upper and Lower Beam)

EXT CRT CATHODE Input connector for intensity modulation (Z-axis) of the display.

CRT Cathode Selector Toggle switch for the CRT cathode circuit.

EXT CRT CATHODE: Normal operation with shorting cover connected. With shorting cover removed, CRT cathode can be intensity modulated with a 10 V or more signal applied to the EXT CRT CATHODE connector.

UPPER BEAM (LOWER BEAM) CHOPPED BLANKING: Permits blanking the Upper (Lower) Beam while the multi-trace plug-in unit is switching from one channel to another during chopped mode of operation.

LINE VOLTAGE SELECTOR ASSEMBLY Facilitates changing the power transformer circuit configuration. The assembly contains a Voltage Selector, a Range Selector and two line fuses. (not incorporated in instruments SN 100-1999).

SELECTION OF PLUG-IN UNITS

The Type 556 Oscilloscope is designed to use Tektronix letter-series and 1-series plug-in units as the input stages for the two vertical deflection systems.

A plug-in unit installed in the left-hand compartment of the oscilloscope is identified as the "left plug-in". This unit provides vertical deflection for the Upper Beam only when the Upper Beam DISPLAY switch is set to the LEFT PLUG-IN positions. Similarly, the plug-in unit installed in the right-hand compartment is referred to as the "right plug-in". This unit, however, provides vertical deflection for both beams simultaneously or for the Lower Beam only, depending on the settings of the DISPLAY switches.

The use ot plug-in units as the vertical inputs permits changing the vertical characteristics of the oscilloscope to meet a wide range of application requirements. The particular plug-in units to be used must be selected to satisfy the requirements of your applications. In selecting the vertical plug-in units, consider the bandpass, risetime, deflection factor, input RC characteristics and the number of inputs. Other plug-in units to consider are special purpose types such as differential amplifiers and comparators, operational amplifiers, spectrum analyzers, etc. Table 2-2 lists a wide variety of plug-in units that can be used with the instrument.

The Type 556 Oscilloscope should not be used without plug-in units installed or connected by extensions. Operating the instrument with a plug-in missing will not damage the oscilloscope, but will cause the vertical amplifier and the sweep generator on that side of the oscilloscope to be inoperative.

TABLE 2-2

VERTICAL PLUG-IN UNITS

(Plug-In/556 system bandwidth characteristics are at 3 dB down)

Plug-In Unit Type	Calibrated Deflection Factor	Bandwidth	Risetime
For Wide-Band, Multiple Trace Applications			
1A1 Dual-Trace	50 mV/cm to 20 V/cm	DC to 50 MHz	7 ns
	5 mV/cm	DC to 28 MHz	12.5 ns
	500 μV/cm	2 Hz to 15 MHz	23 ns
1A2 Dual-Trace	50 mV/cm to 20 V/cm	DC to 50 MHz	7 ns
CA Dual-Trace	50 mV/cm to 20 V/cm	DC to 24 MHz	15 ns
M Four-Trace	20 mV/cm to 10 Vcm	DC to 20 MHz	18 ns
High-Frequency Sampling Applications			
1S1	2 mV/cm to 200 mV/cm		350 ps
1S2	5 mV/cm to 500 mV/cm		90 ps
For Wide-Band Applications			
B	50 mV/cm to 20 V/cm	DC to 20 MHz	18 ns
	5 mV/cm to 20 mV/cm	2 Hz to 12 MHz	30 ns
K	50 mV/cm to 20 V	DC to 30 MHz	12 ns
L	50 mV/cm to 20 V	DC to 30 MHz	12 ns
	5 mV/cm to 2 V/cm	3 Hz to 24 MHz	15 ns
For High DC Sensitivity Applications			
H Wide-Band	5 mV/cm to 20 V/cm	DC to 15 MHz	23 ns
For Differential Input Applications			
D High-Gain	1 mV/cm (to 50 mV/cm)	DC to 300 kHz	0.18 μs
E Low-Level	50 μV/cm (to 10 mV/cm)	0.06 Hz to 20 kHz (to 60 kHz)	6 μs
G Wide-Band	50 mV/cm to 20 V/cm	DC to 20 MHz	18 ns
1A7 High-Gain	10 μV/cm to 10 V/cm	DC to 500 kHz Selectable bandwidth	0.7 μs
For Integration, Differentiation, Function Generation, Linear and Non-Linear Uses			
O Operational Amplifier	50 mV/cm to 20 V/cm	DC to 25 MHz	14 ns
For Transducer and Strain Gage Uses			
Q	10 μstrain/div to 10,000 μstrain/div	DC to 6 kHz	60 μs
For Displaying Simultaneously Delay, Rise, Storage, and Fall Times of Transistors			
R Transistor-Risetime	0.5 mA/cm to 100 mA/cm	DC to 30 MHz	12 ns
For Displaying Forward and Reverse Switching Characteristics of Semiconductor Diodes			
S Diode Recovery	1 mA to 20 mA forward current, 0 mA to 2 mA reverse current	DC to 30 MHz	12 ns
For Precise Amplitude Measurements Via Slide-Back			
W High-Gain Differential Comparator	1 mV/cm to 50 V/cm	DC to 8 MHz at 1 mV/cm, increasing to 23 MHz at 50 mV/cm	44 ns at 1 mV/cm, 15 ns at 50 mV/cm

For Spectrum Analysis

Plug-In Unit Type	Tuning Range
1L5	10 Hz to 1 MHz
1L10	1 MHz to 36 MHz
1L20	10 MHz to 4200 MHz
1L30	925 MHz to 10.5 GHz

In addition, nine narrow-band spectrum analyzers covering frequencies between 10 MHz and 18.2 GHz are available on special order—contact your Local Tektronix Field Engineer or Field Office.

FIRST TIME OPERATION

This procedure describes the basic turn-on precautions and demonstrates the function of the essential general operating controls.

1. Before connecting the instrument to a power source, set the POWER switch to OFF, turn both INTENSITY controls fully counterclockwise and inspect for a power transformer circuit configuration compatible with the actual power source voltage.

2. Install two vertical amplifier type plug-in units, or, if available, two Tektronix Calibration Fixtures, part number 067-0521-00.

3. Connect the instrument to the power source and turn the POWER switch to ON.

4. While waiting for instrument warmup, set the controls of both beams and the plug-in units as follows:

A and B Triggering

A SOURCE	LEFT INT NORM
B SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Clockwise, knob pushed in

A and B Sweep

A TIME/CM and B TIME/CM	.5 SEC
VARIABLE	CALIBRATED
A MODE and B MODE	NORM

Upper and Lower Beam

A DISPLAY	LEFT PLUG-IN A
B DISPLAY	RIGHT PLUG-IN B
POSITION	Centered
DISPLAY MAG	×1
AMPLITUDE CALIBRATOR	50 mVOLTS

Rear Panel

CRT Cathode Selector	EXT CRT CATHODE

Vertical Plug-In Units

Position	Centered
Volts/Cm	.05
Input Selector	AC

Front Panel Adjustments

5. Apply a 50-mV signal from the oscilloscope CAL OUT connector to both vertical plug-in units.

6. Turn the INTENSITY controls clockwise until the displays are of normal brightness.

7. Adjust the A and B Triggering LEVEL control to obtain stable displays.

8. Use the plug-in Position controls to position the displays to the center of their respective graticule viewing areas.

9. Use the Upper and Lower Beam horizontal POSITION controls to position th displays so they start at the left edge of the graticule.

10. Adjust the FOCUS and ASTIGMATISM conrols to obtain well-defined displays.

11. Set the plug-in unit Input Selector switches to Gnd or remove the signal. Check that the traces are parallel to their respective graticule center lines. If they are not, adjust the TRACE ROTATION control for best alignment of the traces with the graticule lines.

12. This completes the basic operation procedure for the Type 556. Instrument operation not explained here, or operation which needs further explanation is discussed under General Operating Information.

GENERAL OPERATING INFORMATION

Light Filters

The mesh filter supplied with the Type 556 provides shielding against radiated EMI (electro-magnetic interference; formerly called RFI) from the face of the CRT. It also serves as a light filter to make the trace more visible under high ambient light conditions. The mesh filter and graticule cover are one unit (Tektronix Part No. 378-0572-00). To remove the filter, remove the four graticule nuts and then remove the graticule cover and mesh filter as a unit.

A tinted light filter is also provided. This filter minimizes light reflections from the face of the CRT to improve contrast when viewing the display under high ambient light conditions. If a light filter is needed and EMI shielding is not required, use the tinted filter to obtain least loss of beam brightness.

NOTE

When using a light filter, avoid the tendency to set the beam intensities so high that they will burn the CRT phosphor.

A clear plastic faceplate protector is provided with the Type 556 for use when the mesh filter or the tinted filter are not used. The clear faceplate protector provides the best display for waveform photographs. It is also preferable for viewing high writing rate displays under low ambient light conditions.

The tinted filter or the faceplate protector should be used at all times to protect the CRT faceplate from scratches. The faceplate protector and the tinted filter are held in place by a graticule cover (Tektronix Part No. 200-0382-00). To remove the light filter or faceplate protector, remove the four graticule nuts and the graticule cover.

Calibrated Graticule

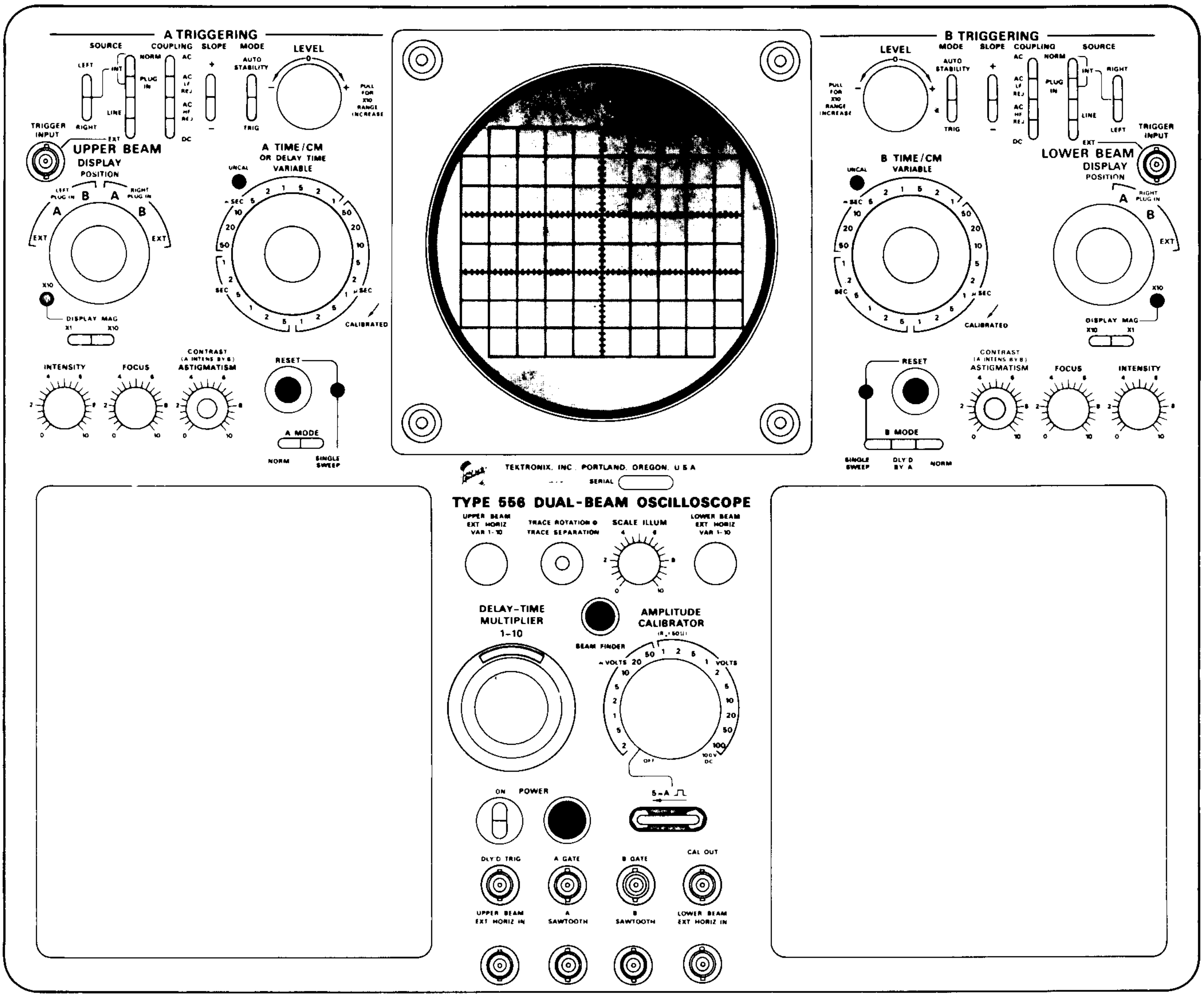
The edge-lighted internal graticule is accurately marked with 8 vertical and 10 horizontal 1-cm divisions. There are 2-mm sub-divisions marked on the vertical center line and the two horizontal center lines (one for each beam). One centimeter of each corner of the graticule is omitted so the graticule fits within the round CRT screen. The deflection factors of the CRT beams are calibrated to the graticule marks. Thus the marks provide a calibrated scale for making time and voltage measurements.

Each beam has a usable vertical scan area of 6 cm. The beams overlap in the center 4-cm area of the graticule to permit superimposed displays.

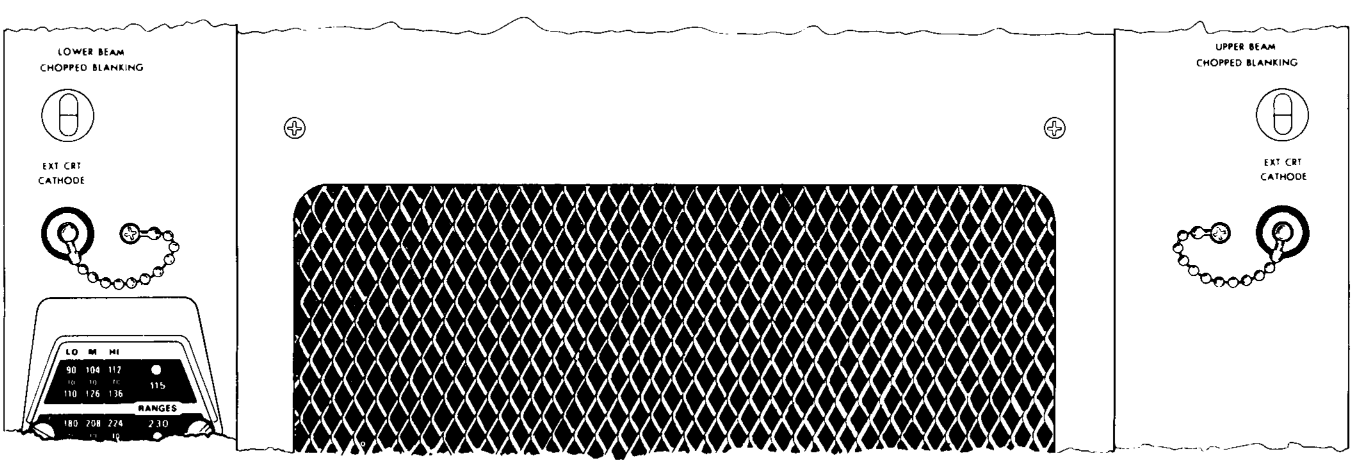
Beam Finder

The BEAM FINDER pushbutton provides a means of locating a display which overscans the viewing area either vertically or horizontally. When the BEAM FINDER button is pressed, the display is compressed within the graticule area. To locate and reposition an overscanned display, use the following procedure.

1. Press the BEAM FINDER button.

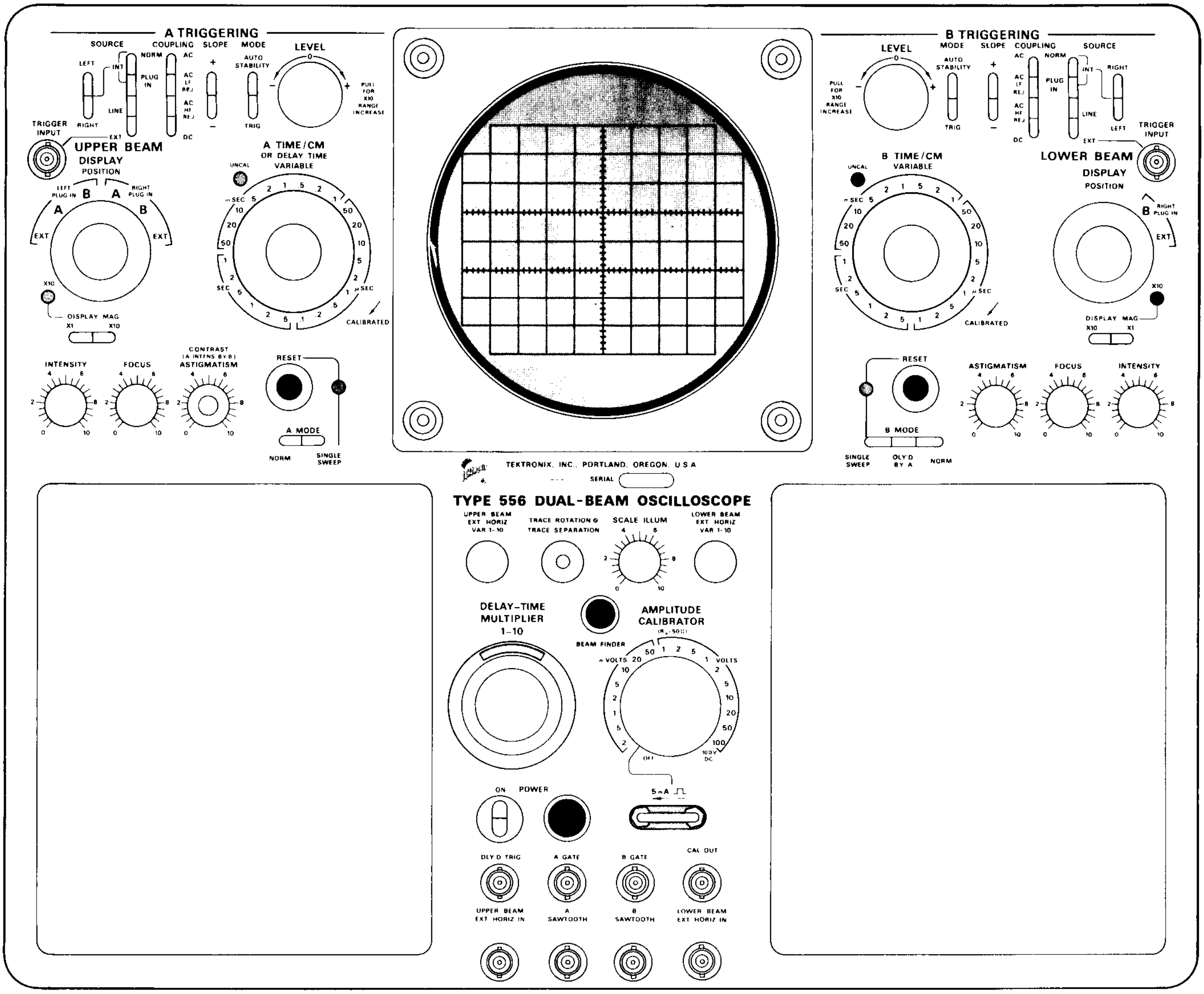


A. Front Panel

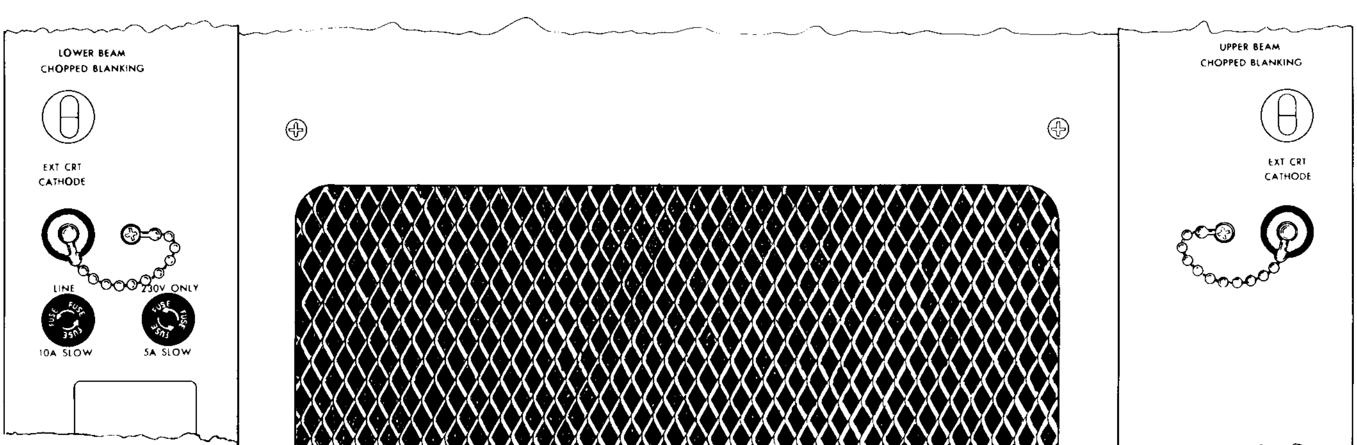


B. Center portion of rear panel.

Fig. 2-3. Control setup chart for Type 556 SN 2000 and up.



A. Front Panel



B. Center portion of rear panel.

Fig. 2-4. Type 556 control setup chart for instruments with serial number 1999 and below.

2. While the BEAM FINDER button is held in, reduce the vertical deflection to less than 3 cm by adjusting the amplitude of the input signal or the deflection factor of the plug-in.

3. Adjust the POSITION controls of the plug-ins and the Type 556 to center the display within the beam viewing area.

4. Release the BEAM FINDER button; the display should appear within the viewing area.

Output Signals

Several low-impedance signal outputs are available at the front panel of the Type 556 Oscilloscope. These are Delayed trigger pulse, a gate waveform from each time base, a sawtooth waveform from each time base, and an Amplitude Calibrator square wave. Typical waveforms are illustrated in Fig. 2-5.

In addition, some multi-trace vertical plug-in units provide an amplified single-channel signal output to be used as a reference for triggering oscilloscopes. Such units apply the single-channel signal to the Type 556 triggering circuits through internal wiring when the SOURCE switches are set to the PLUG IN position.

Use of the gate and sawtooth waveforms for triggering or driving external devices is illustrated in Fig. 2-6. In this application, the time base is usually set for a free-running sweep.

In addition to the sawtooth outputs on the front panel, there is an internal sawtooth voltage that is applied to pin 6 of both plug-in interconnecting jacks. For the left plug-in unit the sawtooth voltage originates from the A Sweep Generator; for the right plug-in unit the sawtooth voltage originates from the B Sweep Generator. These sawtooth voltages provide a standardized current ramp of 20 μA/cm (nominal) via a standardizing resistor for use in driving plug-in spectrum analyzers requiring this signal source.

The internal current ramps can also be used to drive low-impedance circuits, such as the minus input of an operational amplifier or the emitter of a transistor, with a positive-going linear ramp of current. The internal and external sawtooths from each sweep may not drive two circuits when both outputs are used at the same time, nor will the internal sawtooth successfully serve as a voltage signal source—especially at the faster sweep rates.

When pin 6 is not used, the high impedance of this sawtooth signal source prevents excessive cross-talk of the signal into the plug-in unit.

Control Setup Chart

Fig. 2-3 and Fig. 2-4 show the front panel and a portion of the rear panel of the Type 556. If the controls of the plug-in unit being used are sketched in, the completed picture may be reproduced and used as a test setup record for special measurements, applications or procedures, or may be used as a training aid for familiarization with this oscilloscope.

Vertical Controls

The vertical plug-in unit for each beam contains all the front-panel vertical positioning and deflection controls for that beam with the exception of the TRACE SEPARATION control. Refer to the instruction manuals of the particular plug-in units for operation of the vertical controls.

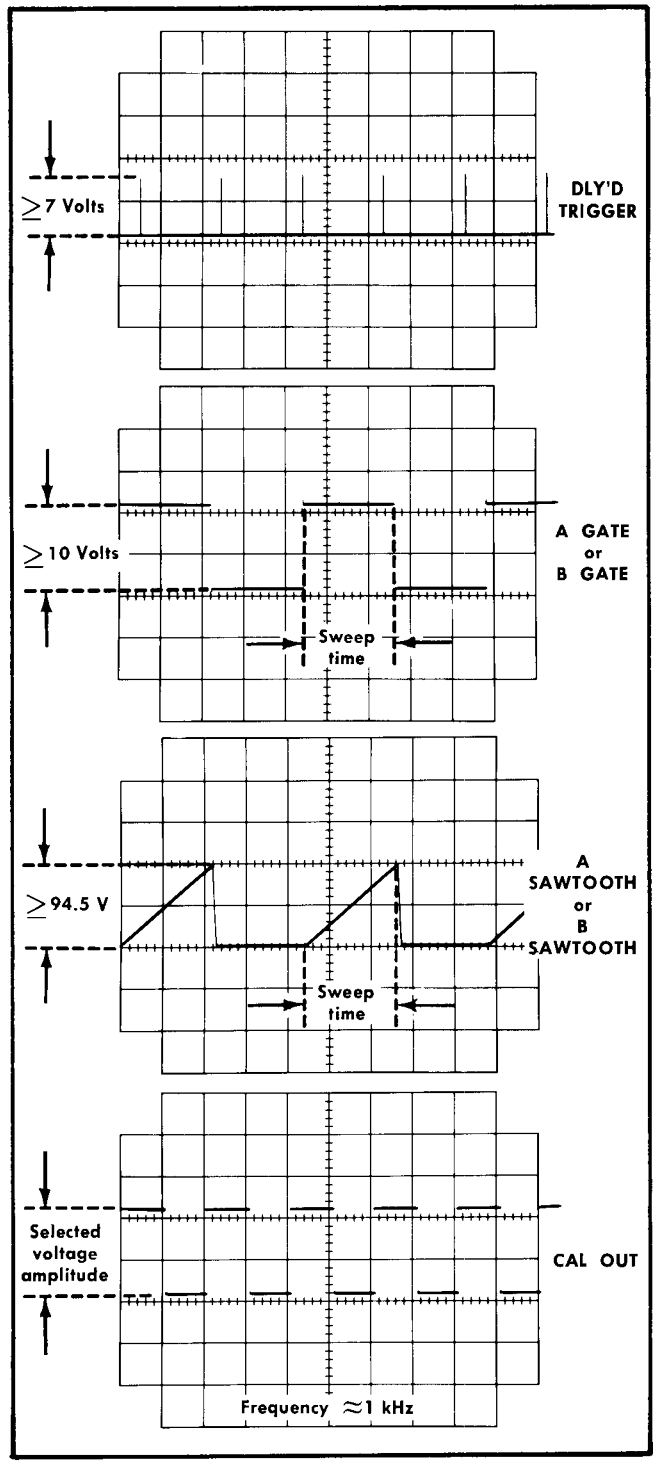


Fig. 2-5. Output waveforms available at the front panel.

CONNECTING TO THE SIGNAL SOURCE

Input signals that are to be displayed as vertical deflection on the CRT screen are applied to the input connectors on the two vertical plug-in units.

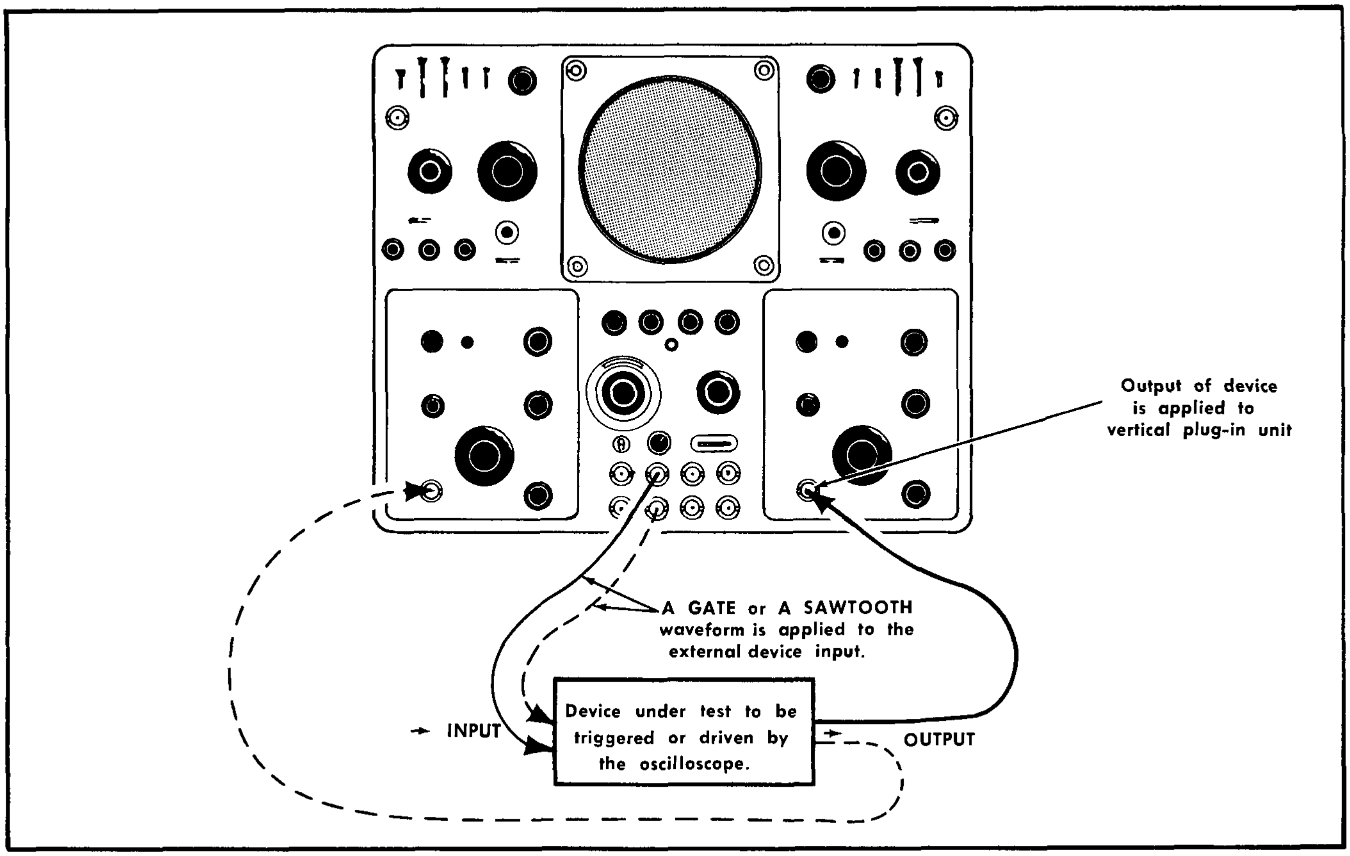


Fig. 2-6. Using the A GATE or A SAWTOOTH waveform to trigger or drive an external device. Sweep is usually free running.

Use of Coaxial Cables

In general, coaxial cables should be used to connect the signal source to the vertical input. The use of coaxial cables nearly eliminates pickup from stray electromagnetic fields, and also eliminates radiation from the connecting cables by grounding the outside conductors. It is sometimes possible to use an unshielded input lead if the signal amplitude is high and if its frequency is low. When an unshielded lead is used, connect another lead between the oscilloscope chassis and the chassis of the signal source.

In high-frequency work it is usually necessary to terminate signal sources and connecting cables in their characteristic impedances. Unterminated connections result in signal reflections within the cables and cause distortion of the displayed waveforms. The input coaxial cable will often serve to terminate the signal source, and a termination placed at the input of the plug-in unit will provide sufficient termination for signal reflections. However, if the source impedance is considerably different from that of the connecting cable, the source end of the cable may also need to be terminated.

When connecting an input signal, the loading effect of the oscilloscope on the signal source must be considered. The resistance at the input of the vertical plug-in unit is usually 1 megohm which adequately limits low-frequency loading to a negligible value. However, at high frequencies, the input capacitance of the vertical plug-in and the distributed capacitance of the input cable become significant. Capacitive loading at high frequencies may be sufficient to adversely affect both the displayed waveform and the operation of the signal source. Attenuator probes can be used to reduce capacitive and resistive loading to very small values.

Use of Probes

In addition to reducing the load on the signal source, an attenuator probe also decreases the amplitude of the displayed waveform by the attenuation factor of the probe. This permits observation of signals beyond the normal amplitude limits of the oscilloscope and plug-in combination. Signal amplitudes, however, must be limited to the maximum allowable value of the probe being used.

Before a probe is used, it must be compensated to operate properly with the plug-in unit. Compensation of the probe is adjusted according to the procedure given in the instruction manual with the vertical plug-in unit and in the instructions accompanying the probe. In general, this adjustment is done by connecting the probe cable to one of the vertical inputs and observing several cycles of the calibrator waveform on the CRT screen. The compensating capacitor is then adjusted to provide minimum distortion of the top and leading corner of the square-wave signal (see Fig. 2-7).

Trigger Source

INT. For most applications, the sweep can be triggered internally. In the INT positions of the SOURCE switch, the

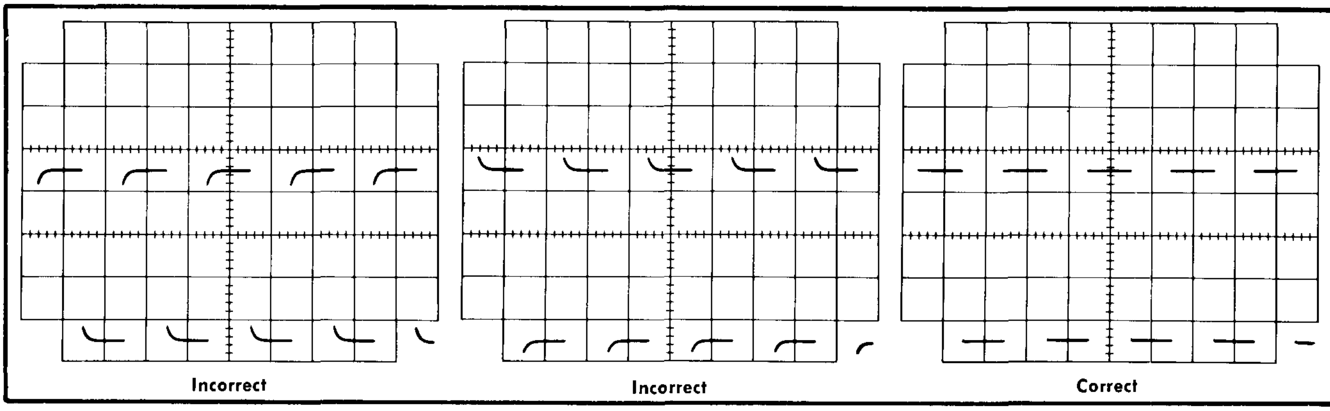


Fig. 2-7. Probe compensation waveforms.

trigger signal is obtained from the vertical system. The SOURCE switch provides further selection of the internal trigger signal as follows:

(1) **LEFT INT NORM**; triggering is obtained from the left vertical amplifier. For single-trace displays this position provides the most convenient operation. However, for multi-trace displays, special considerations must be made to provide the correct display. For further information refer to (3) LEFT INT PLUG IN and the plug-in instruction manual.

(2) **RIGHT INT NORM**; triggering is obtained from the right vertical amplifier. The information about single-trace and multi-trace displays given for the LEFT INT NORM position also applies for this position.

(3) **LEFT INT PLUG IN**; for a multi-trace plug-in unit in the left oscilloscope compartment that can supply a single-channel triggering signal through pin 5 of the interconnecting plug, such as the Tektronix Types 1A1 and 1A2 Dual-Trace Plug-In Units. This position is useful when operating the plug-in unit in dual-trace chopped-mode operation since the triggering signal is the same as the applied signal and is free from the chopping rate switching transients. Also, this position is useful when operating the plug-in in dual-trace alternate operation to show true time relationship between input signals.

(4) **RIGHT INT PLUG IN**; same applications for (3) LEFT INT PLUG IN except this is for a multi-trace plug-in unit that is inserted in the right plug-in compartment of the oscilloscope.

LINE. The LINE position of the SOURCE switch connects the power-line frequency to the Sweep Trigger circuit. Line triggering is useful when the input signal is time-related to the line frequency. It is also useful for providing a stable display of a line-frequency component in a complex waveform.

EXT. An external signal connected to the TRIGGER INPUT connector can be used to trigger the sweep in the EXT position of the SOURCE switch. The external signal must be time-related to the displayed signal for a stable display. An external trigger signal can be used to provide a triggered display when the internal signal is too low in amplitude for correct triggering, or contains signal components on which it is not desired to trigger. It is also useful when signal tracing in amplifiers, phase-shift networks, wave-shaping circuits, etc. The signal from a single point in the circuit can be connected to the TRIGGER INPUT connector through a signal probe or coaxial cable. The sweep is then triggered by the same signal at all times and allows amplitude, time relationship or waveshape changes of signals at various points in the circuit to be examined without resetting the triggering controls.

Trigger Coupling

Four methods of coupling the trigger signal to the trigger circuits can be selected with the Triggering COUPLING switch. Each position permits selection or rejection of the frequency components of the trigger signal which will trigger the sweep.

AC. The AC position blocks the DC component of the trigger signal. Signals with low-frequency components below about 30 Hz will be attenuated. In general, AC coupling can be used for most applications. However, if the trigger signal contains unwanted frequency components or if the sweep is to be triggered at a DC level, one of the remaining COUPLING switch positions will provide a stable display.

The triggering point in the AC position depends on the average voltage level of the trigger signal. If the trigger signals occur in a random fashion, the average voltage level will vary, causing the triggering point to vary also. This shift of the triggering point may be enough so it is impossible to maintain a stable display. In such cases, use DC coupling.

AC LF REJ. In the AC LF REJ position, DC is rejected and signals below about 2.5 kHz are attenuated. Therefore, the sweep will be triggered only by the higher-frequency components of the signal. This position is particularly useful for providing stable triggering if the trigger signal contains line-frequency components. Also, when operating multi-trace plug-in units in the alternate mode, the AC LF REJ position can provide a brighter display at the higher sweep rates. The smaller value coupling capacitor used in the sweep trigger circuit allows the circuit to recover faster, thus increasing its trigger-rate capability for triggering the sweep.

AC HF REJ. The AC HF REJ position passes all low-frequency signals between about 60 Hz and 60 kHz. DC is

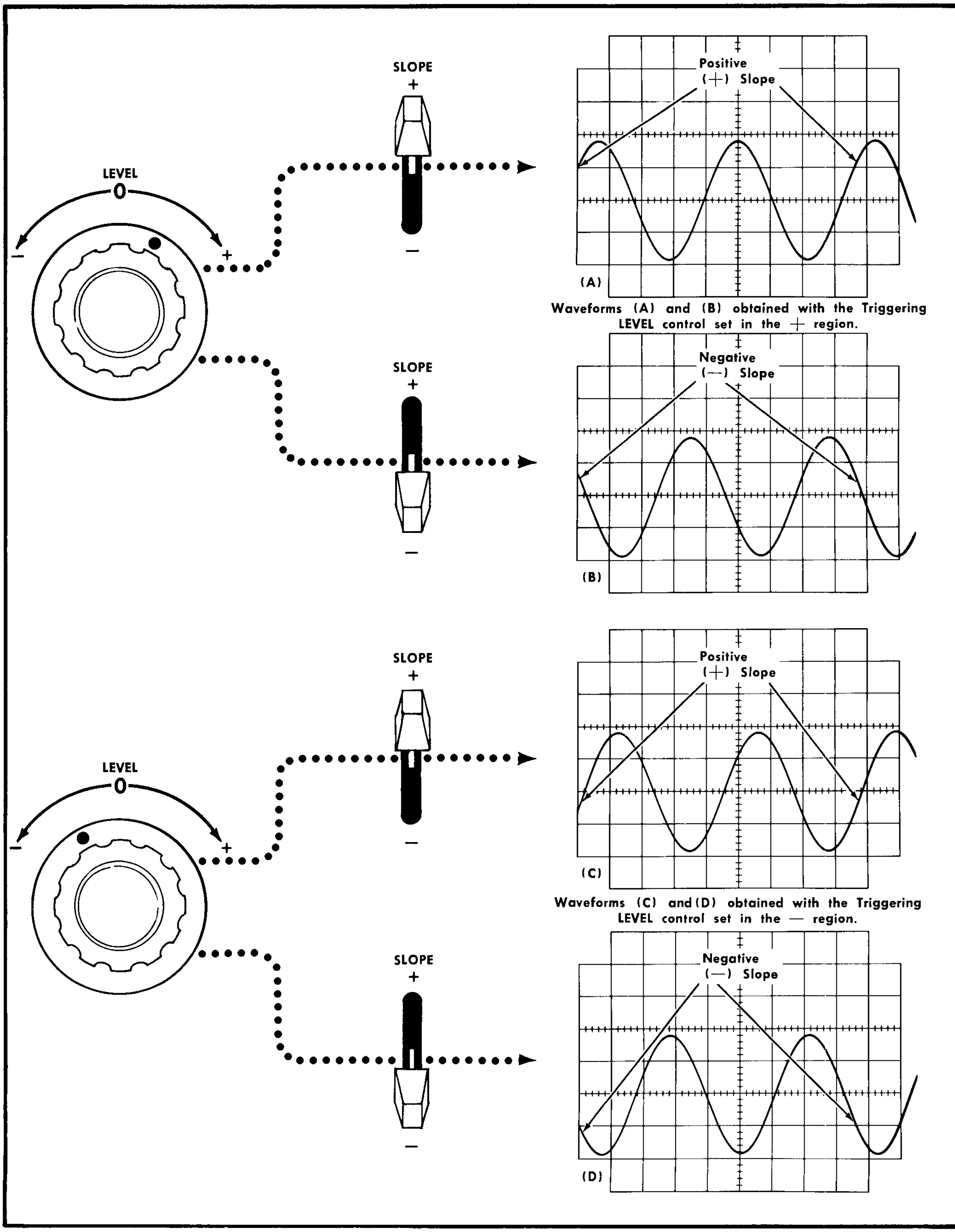


Fig. 2-8. Effects of Triggering LEVEL control and SLOPE switch.

rejected and signals outside the given range are attenuated. When triggering from complex waveforms, this position is useful for providing a stable display of low-frequency components.

DC. DC coupling can be used to provide stable triggering with low frequency signals which would be attenuated in the AC or AC HF REJ positions, or with low-repetition rate signals. The LEVEL control can be adjusted to provide triggering at the desired DC level on the waveforms. When using INT NORM triggering, the setting of the plug-in vertical Position control will affect the DC trigger level.

When the SOURCE switch is set to INT NORM, DC trigger coupling should not be used during alternate mode operation of a multi-trace plug-in unit. If used, the sweep will trigger on the DC level of the signal from one channel and then either lock out completely or free run on the signal from the other channel. Correct DC triggering on the first channel in this mode can be obtained if the SOURCE switch is set to the INT PLUG IN position for a plug-in unit having an internal channel 1 output trigger.

Trigger Slope

The Triggering SLOPE switch determines whether the trigger circuit responds on the positive-going or negative-going portion of the trigger signal. When the SLOPE switch is in the + (positive-going) position, the display will start with the positive-going portion of the waveform; in the — (negative-going) position, the display will start with the negative-going portion of the waveform (see Fig. 2-8). When several cycles of a signal appear in the display, the setting of the SLOPE switch will probably be unimportant. However, if only a certain portion of a cycle is to be displayed, correct setting of the SLOPE switch will provide a display which starts on the desired slope of the input signal.

Trigger Mode

AUTO STABILITY. The automatic stability mode is generally the most convenient to use. It is particularly useful where a reference trace is needed in the absence of a trigger signal. To use this triggering mode, set the MODE switch to AUTO STABILITY and set the Triggering LEVEL control for proper triggering to obtain a stable display. When the triggering signal is removed, the sweep generator circuit will free run to present a reference trace on the CRT.

TRIG. The TRIG position of the MODE switch should be used if AUTO STABILITY position is undesirable or if the trigger signal has a very low repetition rate (below about 30 Hz).

Trigger Level

The Triggering LEVEL control determines the voltage level on the triggering waveform at which the sweep is triggered. When the LEVEL control is set in the + region, the trigger circuit responds at a more positive point on the trigger signal. When the LEVEL control is set in the — region, the sweep trigger circuit responds at a more negative point on the trigger signal. Fig. 2-8 illustrates this effect with different settings of the SLOPE switch.

To set the LEVEL control, first select the Triggering SOURCE, COUPLING and SLOPE switch positions. Then set the LEVEL control a few degrees either side of 0 (except for TRIG mode and DC coupling). If the display does not start at the desired point, adjust the LEVEL control for correct triggering.

In the DC position of the COUPLING switch, correct triggering may be obtained at any setting of the LEVEL control depending on the DC level of the trigger signal. To obtain correct triggering, set the LEVEL control fully counterclockwise. Then turn the LEVEL control clockwise until the display is triggered at the correct DC level.

When the LEVEL control is pulled outward its range is extended 10 times. The pulled outward position is useful for triggering on large amplitude signals. When the LEVEL control is pushed in, the range of the control is decreased and is most useful for signals of smaller amplitude.

Free Run

To free run the sweep in the absence of trigger signals, set the Triggering MODE switch to AUTO STABILITY and the LEVEL control to any setting. A free running sweep is convenient when a reference trace is needed. If trigger signals are present, set the LEVEL control at either end of its range. This will allow the sweep to free run with the LEVEL control pushed in when the trigger amplitude is small, and with the LEVEL control pulled out when trigger amplitude is large. If it is desirable to free run the sweep in the presence of a larger input signal, set the SOURCE switch to some position not receiving input triggers; e.g., EXT.

With a free running sweep, one of the sweep generators can be used to initiate a gate or sawtooth signal to trigger or drive an external device under test. Fig. 2-6 illustrates this mode of operation using the A Gate or A Sawtooth and the Lower Beam. The signal applied to the device will then be synchronized with the sweep repetition rate of the sweep generator and will present a stable display on the CRT. Set the A TIME/CM switch and VARIABLE control to produce the desired repetition rate.

Another way to display the waveform of the A Gate, A Sawtooth, or the waveform from the external device is to apply the desired waveform to the Left Plug-In input connector. Next, set the Upper Beam DISPLAY switch to LEFT PLUG-IN B and use the B TIME/CM switch to obtain the desired display on the upper beam.

If the device has two output signals, apply the second signal from the device to the Right Plug-In input connector (see Fig. 2-6 dotted line). Set the Lower Beam DISPLAY switch to RIGHT PLUG-IN B. The two beams will then display the waveforms simultaneously. Similarly, more than two output signals from the external device may be displayed together by using both beams and multi-trace plug-in units.

Selecting Sweep Rate

The A and B TIME/CM switches select calibrated sweep rates for their respective Sweep Generators. The VARIABLE control associated with the TIME/CM switch provides continuously variable sweep rates between the settings of the TIME/CM switch. Whenever the UNCAL light for either A or B is on, the sweep rate of either A or B Sweep Generator (or both if both UNCAL lights are on) is uncalibrated. The light is off when the associated VARIABLE control is set to the CALIBRATED position.

When making time measurements from the graticule, the area between the first-cm and ninth-cm graticule lines provides the most linear time measurement (see Fig. 2-9). Therefore, the first and last centimeters of the display should not be used for making accurate time measurements. Position the display area to be timed so the timing area starts at the first centimeter graticule line. Set the TIME/CM switch so the end of the display timing area falls between the first and ninth cm graticule lines.

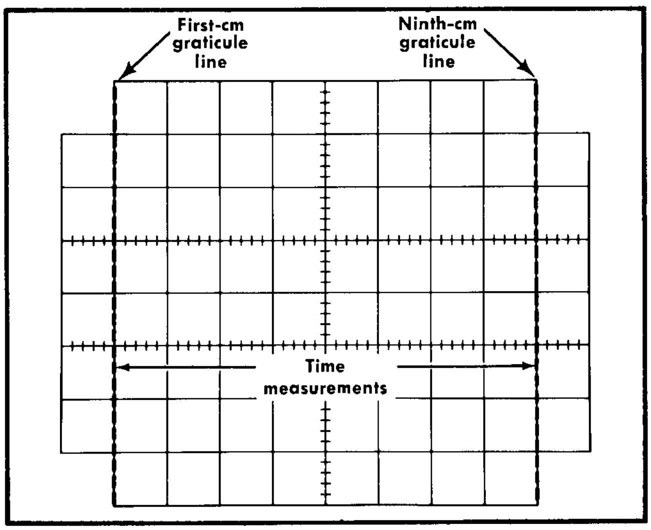


Fig. 2-9. Area of graticule used for obtaining accurate time measurements.

Display Magnification

The displayed sweep is magnified ten times by setting the DISPLAY MAG switch from ×1 to the ×10 position. In the ×1 position the center one-centimeter portion of the unmagnified display is the portion visible on the CRT in magnified form (see Fig. 2-10). Note that the display expands equally to each side from graticule center. Equivalent length of the magnified sweep is 100 cm. Thus, any 10-cm portion of the display can be viewed by adjusting the horizontal POSITION control to bring the desired portion into the viewing area. The light located near the DISPLAY MAG switch is on whenever the switch is set to ×10.

When the DISPLAY MAG switch is set to ×10, the sweep rate is determined by dividing the TIME/CM switch setting by 10. For example, if the TIME/CM switch is set to .5 μSEC, the magnified sweep rate is 0.05 μs/cm. The magnified sweep rate must be used for all time measurements when the DISPLAY MAG switch is set to ×10. The magnified sweep rate is calibrated when the UNCAL light is off.

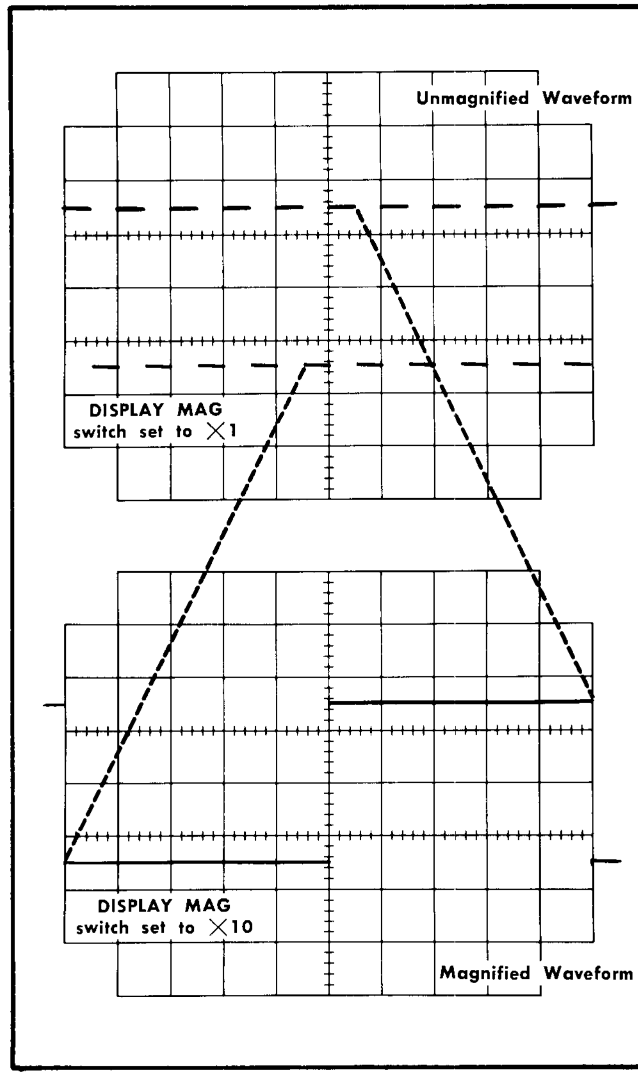


Fig. 2-10. Operation of display magnifier.

Using the Position Controls

The two beams have independent horizontal positioning. The Upper Beam horizontal POSITION control positions the Upper Beam display; the Lower Beam horizontal POSITION control positions the Lower Beam display. Clockwise rotation of either control causes the trace of the particular beam to move to the right on the CRT screen, and counterclockwise rotation moves the trace to the left. When the DISPLAY MAG switch is set to ×10, the POSITION control has sufficient range to view any portion of the magnified display.

The POSITION control operates as a combination coarse and fine adjustment of the positioning by means of a backlash coupling between the two sections of the control. To position the trace or display horizontally, turn the POSITION control slightly past the point desired, then move the display to the final location. The fine adjustment section of the control operates only in the backlash of the coarse adjustment section. For example, to move the display to the right when the DISPLAY MAG switch is set to ×1, rotate the POSITION control clockwise until the display is about 2 mm past the desired location, then turn the control slightly counterclockwise for a fine adjustment of the display position.

Single Sweep

When the signal to be displayed is non-repetitive, or if the signal is repetitive but varies in amplitude, shape or time so a stable display is difficult to obtain, use the single-sweep feature of the Type 556.

To use the single-sweep mode, first set the Triggering MODE switch to TRIG and then be sure to set the LEVEL control so the sweep trigger circuit will trigger on the event that is to be displayed. Using the Upper Beam controls as an example, set the A Triggering controls for proper triggering. Then set the A MODE switch to SINGLE SWEEP and press the RESET button. After the button is pressed, the next trigger pulse will initiate the sweep and a single trace will be presented by the Upper Beam.

After the sweep ends in the given example, the A Sweep Generator will be locked out until reset by pressing the RESET button once again. The RESET light located near the RESET button will light when the A Sweep Generator circuit has been reset and will go out after the sweep has been triggered.

Delayed B Sweep

The delayed B sweep is operable in the DLY'D BY A (B sweep delayed by A sweep) position of the B MODE switch. The A Sweep determines the time that the B Sweep is delayed. Sweep rate of the delayed portion is determined by the B TIME/CM switch.

When using DLY'D BY A mode of operation, the dual-beam display will appear similar to Fig. 2-11. Referring to the Upper Beam display in the illustration, the amount of delay time between the start of the A Sweep and the intensified portion is determined by the setting of the A TIME/CM switch and the DELAY-TIME MULTIPLIER dial. Brightness level of the Upper Beam delaying A sweep, excluding the intensified portion, can be varied by rotating the CONTRAST control. (The brightness of the intensified portion can be changed by rotating the INTENSITY control.)

NOTE

The OR DELAY TIME portion of the A TIME/CM OR DELAY TIME switch name as it appears on the front panel applies to delayed B sweep mode of operation. For simplicity, the switch is usually called A TIME/CM in this manual.

Fig. 2-12 shows the DELAY-TIME MULTIPLIER dial. The outer numbers are major dial divisions and inner numbers are minor dial divisions. For example, the DELAY-TIME MULTIPLIER dial reading as shown in Fig. 2-12A is 3.55; 3 maor divisions and 55 minor divisions. This reading multiplied by the setting of the A TIME/CM switch gives the calibrated delay time of the B Sweep (see Fig. 2-12B).

The intensified portion of the Upper Beam display is produced by the B Sweep. Time duration of this portion is governed by the setting of the B TIME/CM switch. The B TIME/CM switch should always be set for a sweep rate which is faster than the A TIME/CM switch setting. The Lower Beam (as shown in Fig. 2-11) is used to display the intensified portion in magnified form for detailed examination.

The delayed B sweep is usually operated in two basic modes: (1) B sweep starts automatically after the delay time, and (2) B sweep starts only when triggered after the delay time.

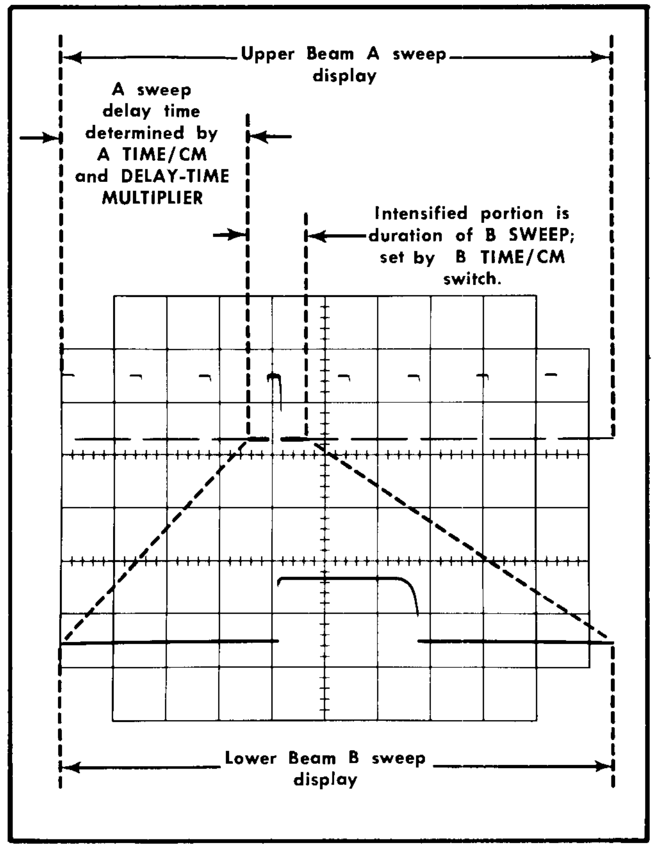


Fig. 2-11. DLY'D BY A mode of operation. The intensified portion of the Upper Beam is expanded and displayed by the Lower Beam. A TIME/CM, .5 mSEC; B TIME/CM, 50 μSEC.

Mode 1: B Sweep Starts Automatically After Delay Time. In this mode of operation the B sweep starts approximately 150 ns following the delay time (see Figs. 2-10 and 2-13A). Since the delay time is the same for each sweep, the display will appear stable. Basically the setup is as follows:

1. Preset the right plug-in vertical deflection factor so the signal to be applied in step 2 will not overdrive the plug-in unit but will produce an on-screen display.

2. Apply the signal to the right vertical plug-in unit.

6. Preset the DELAY-TIME MULTIPLIER control for a dial reading between 1.00 and 9.50.

7. Set the A Triggering controls for normal internal triggering on the right plug-in signal.

8. Set these B Triggering controls as follows:

LEVEL	Fully clockwise and knob pulled outward
MODE	AUTO STABILITY

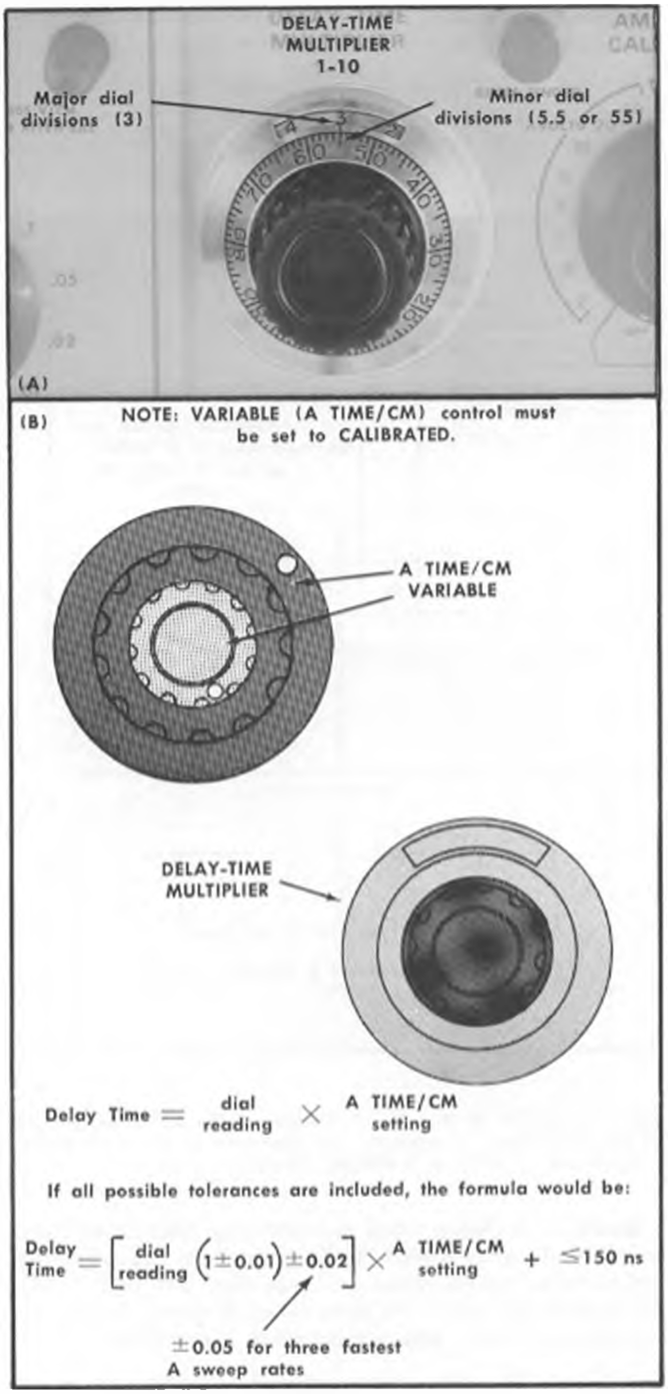


Fig. 2-12. (A) DELAY-TIME MULTIPLIER dial. Reading shown is 3.55. (B) Delay time is calculated by multiplying the A TIME/CM sweep rate by the DELAY-TIME MULTIPLIER dial reading.

9. The Upper Beam display should have an intensified portion indicating the delayed B sweep time duration. If necessary, adjust the CONTRAST control to show clearly the difference between the unintensified and intensified portions. The Lower Beam should show a magnified display of the intensified portion (similar to Fig. 2-13A).

10. Turn the DELAY-TIME MULTIPLIER control and note that the intensified portion moves smoothly along the Upper Beam display. Thus, any portion of the Upper Beam display, except the extreme ends, can be magnified by the Lower Beam by controlling the starting time of the B sweep with the DELAY-TIME MULTIPLIER control. The dial readings indicate the number of major graticule divisions between the beginning of the Upper Beam display and the intensified portion of the trace.

The degree of display magnification presented in this manner is equal to the ratio of the Upper Beam sweep rate to the Lower Beam sweep rate. For example, if the A TIME/CM switch is set to .5 mSEC and the B TIME/CM switch is set to 5 μSEC, the magnification is 100 times.

If some signal other than the one applied to the right plug-in unit is applied to the left plug-in unit and displayed by the Upper Beam, the intensified portion will still indicate the time relationship between the two sweeps, but the Lower Beam will not be a magnified view of the Upper Beam display.

Mode 2: B sweep starts only when triggered after delay time. This mode allows the B sweep to be triggered by any triggering event following the delay time (see Fig. 2-13B). To demonstrate, set up the Type 556 controls in the same manner as described previously for Mode 1, except this information should be substituted for steps 8 through 10.

Set the B triggering controls as follows:

Mode	TRIG
SLOPE, COUPLING	As desired
SOURCE	NORM INT, RIGHT
LEVEL	For proper triggering on right plug-in signal

Then turn the DELAY-TIME MULTIPLIER control and notice that the B sweep can be triggered by the applied signal any time after the delay time interval. The brightened portion of the Upper Beam display will jump from one triggering point on a cycle of the waveform to the same triggering point on the next cycle of the waveform as the DELAY-TIME MULTIPLIER control is turned.

If no triggering signal is applied to the B sweep generator at the completion of the delay period, the Lower Beam will be held off until a triggering pulse is received. The B MODE RESET lamp will light to indicate that the sweep is ready to be triggered. Then, when the trigger signal appears, the B sweep generator will sweep and the RESET lamp will turn off. Thus, the time between the start of the A sweep and the start of the B sweep will depend on the occurrence of the B sweep triggering signal as well as on the settings of the delay time controls.

If separate triggering signals are applied, the B sweep might occur at any time following the delay time period. Therefore the intensified portion of the Upper Beam display may appear any place past the delay time period, or might not appear at all if there is no triggering signal.

Delayed Trigger

To use the delayed trigger pulses for triggering an external device, connect a coaxial cable from the DLY'D TRIG connector to the device under test and to the left plug-in Input connector. Connect the output signal from the device to the right plug-in unit Input connector. Connect a coaxial cable from the A GATE to the B TRIGGER INPUT connector.

Set these controls as follows:

A Triggering

MODE	AUTO STABILITY
LEVEL	Fully cw and knob pulled outward (to free run the A sweep)

B Triggering

MODE	TRIG
SLOPE, COUPLING	As desired
SOURCE	EXT
Upper Beam DISPLAY	LEFT PLUG-IN A
Lower Beam DISPLAY	RIGHT PLUG-IN B
A MODE & B MODE	NORM

The delayed triggered pulse is now triggering the device under test. One output pulse will occur for each A sweep, at a time determined by the setting of the DELAY-TIME MULTIPLIER control. To select the delay time, set the A TIME/CM switch and the DELAY-TIME MULTIPLIER control so their product equals the desired delay time from 0.1 μs to 50 seconds (see Fig. 2-12B). Set the B Triggering LEVEL and the B TIME/CM switch to obtain a stable Lower Beam display of the device output waveform.

The Upper Beam is being used to monitor the delay trigger pulse. Each whole number on the DELAY-TIME MULTIPLIER dial represents 1 cm of pulse displacement from the left edge of the graticule. Since the DELAY-TIME MULTIPLIER control determines the time of occurrence of the delayed pulse, it can be used for positioning the Lower Beam display.

The A sweep generator can be either triggered or free run. If it is operated in a free run mode the repetition rate of the delayed trigger pulses will be the same as the repetition rate of the A Sweep Generator circuit at that particular setting of the A TIME/CM switch. (This rate can be varied from 0.02 Hz to about 70 kHz with the A TIME/CM switch.)

If the A sweep generator is operated in a triggered mode, an output delayed trigger pulse will occur after the A sweep generator has been triggered and has swept for the duration of the delay time period. The A sweep generator must complete its sweep and retrace before it can be triggered again. Thus the repetition rate of the delayed pulse output when the A sweep generator is triggered will depend on both the frequency of the triggering signal and the repetition rate of the A sweep generator circuit.

The Lower Beam can be used for displaying more than one cycle of the device output signal by setting the B TIME/CM switch to a lower sweep rate than the A TIME/CM switch. The Lower Beam can also be used to expand a portion of the waveform if the B TIME/CM switch is set for a faster sweep rate than the A TIME/CM switch. Since the A GATE is triggering the B Sweep and the delayed trigger is triggering the device, the display can be positioned with the DELAY-TIME MULTIPLIER control.

External Horizontal Deflection

To deflect one of the CRT beams horizontally with an externally-derived voltage signal, apply the external signal to the UPPER BEAM EXT HORIZ IN or LOWER BEAM EXT HORIZ IN connector and set the corresponding DISPLAY switch to EXT.

If the UPPER BEAM EXT HORIZ IN connector is used and the Upper Beam DISPLAY switch is set to LEFT PLUG-IN EXT position, the left plug in provides the vertical deflection and the external signal provides the horizontal deflection of the Upper Beam. If the Upper Beam DISPLAY switch is set to RIGHT PLUG-IN EXT, the right plug in deflects the Upper Beam vertically and the external signal deflects the Upper Beam horizontally.

The horizontal deflection factor can be varied from about 1 V/cm to 10 V/cm by means of the corresponding UPPER BEAM EXT HORIZ VAR or LOWER BEAM EXT HORIZ VAR control, when the appropriate DISPLAY MAG switch is set to $\times 1$ and from about 0.1 V/cm to 1 V/cm when the appropriate DISPLAY MAG switch is set to $\times 10$.

Horizontal deflection with an external voltage signal provides low frequency X-Y operation of the oscilloscope for comparing one function to another (e.g., Lissajous figures) or for making phase comparisons. However, this system is not intended for precise phase-angle measurements. The upper limit of the horizontal frequency response is 3 dB down at about 400 kHz; therefore, X-Y operation should be limited to signals below this frequency.

Time relationship of the X-Y display may be provided through intensity modulation with 10 to 20 V timing pulses.

Intensity Modulation

The two beams have separate EXT CRT CATHODE input connectors on the rear panel for application of intensity modulation signals.

To modulate one of the CRT beams, remove the connector cover from the EXT CRT CATHODE connector, check that the CRT Cathode Selector switch is set to the EXT CRT CATHODE position, and then apply a 10 to 50 V signal to the EXT CRT CATHODE connector. Positive-going voltage signals decrease the beam intensity and negative-going voltage increases the intensity from the level set by the appropriate INTENSITY control.

Intensity modulation can be used to relate other voltage information to the displayed signal without changing the shape of the waveform. Intensity time markers can be added to make time measurements more precise than those obtainable from the graticule marks. Identical signals applied to the two beams can be used to horizontally reference the two beams on the CRT screen or to correlate them in time.

NOTE

Be sure to replace the connector grounding cover on the EXT CRT CATHODE connector when this input is not being used.

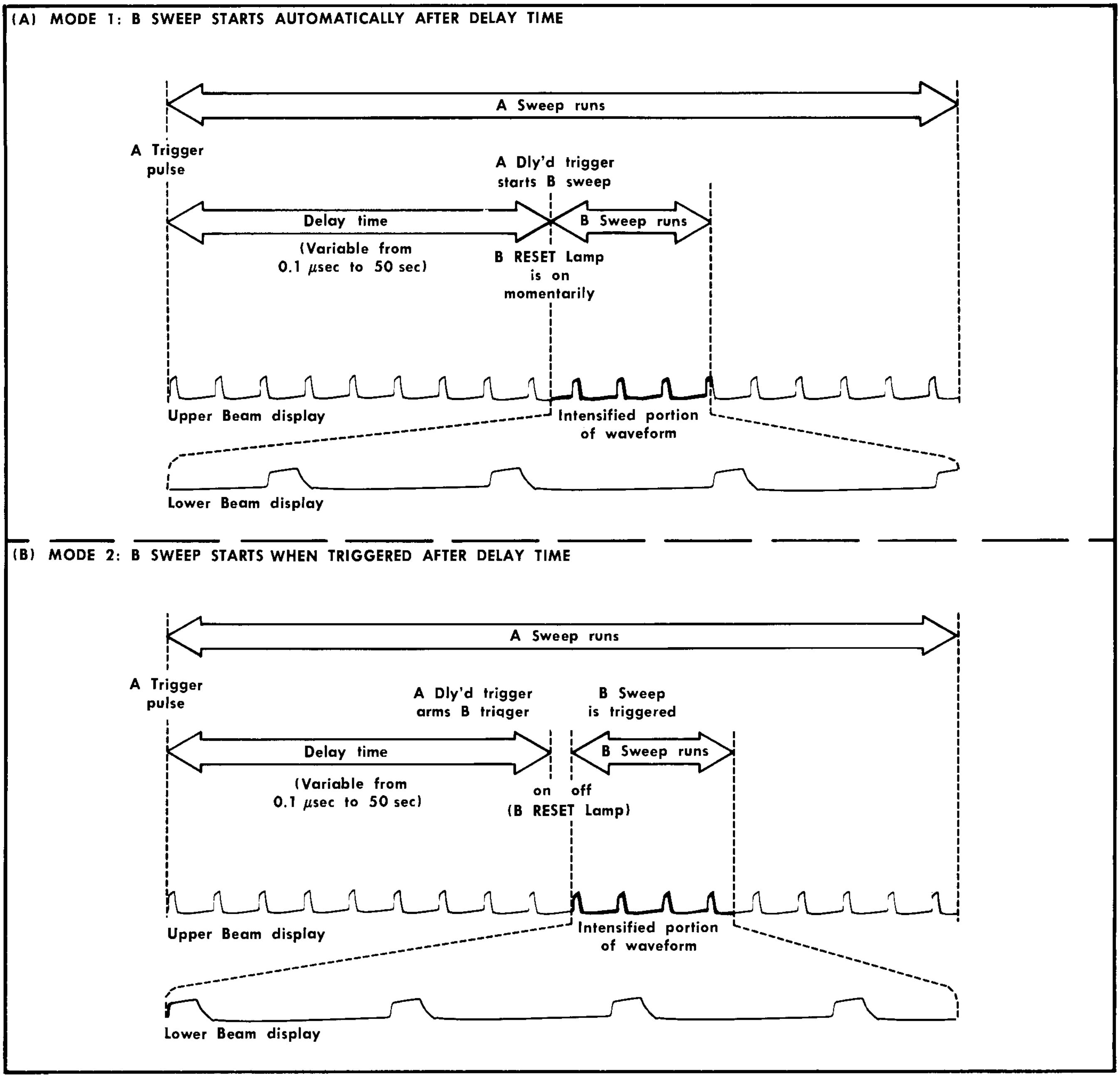


Fig. 2-13. Comparison of the two delayed-sweep modes. In each case the Upper Beam presentation represents the input to both vertical systems. The intensified portion of the Upper Beam display shows the part of the input wavefrom that is displayed by the Lower Beam.

Multi-Trace Operation Using Independent Deflection Systems

When the plug-in units are set for alternate-trace mode of operation, the oscilloscope supplies an alternate-trace sync pulse from each of its sweep generators for channel switching in multi-trace vertical plug-in units. The use of multi-trace units in either alternate or chopped mode of operation provides simultaneous viewing of several input signals. All of, the traces resulting from one multi-trace unit will be displayed on one beam at the same sweep rate.

corresponding signal in that channel during alternate mode of operation. For chopped mode operation, triggering occurs

For multi-trace plug-in units that have a single-channel trigger pickoff circuit, the trigger from one channel is applied internally from the plug in to the Sweep Trigger circuit when the SOURCE switch is set to the LEFT INT PLUG IN or RIGHT INT PLUG-IN position, depending on which plug-in is selected. This permits internal triggering on only the one channel input signal, thus showing the time relationships of the multi-channel displayed waveforms.

For multi-trace units without a single-channel trigger output, each trace will be triggered on the waveform from the on the composite signal consisting of the signals in all the channels plus the chopping signal. If the time relationships of the signals are of interest, and external trigger signal can be used, or the triggers can be derived from a time-related single input applied to the other beam.

Provision is included in the oscilloscope for blanking the between-channel switching transients when operating a multi-trace plug-in unit in the chopped mode. During each sweep in this mode, a sequence of rapid switching occurs from one channel to the next, so that the signal in one channel is displayed for an instant, then the signal in the next channel. To blank the CRT beam during the period while the multi-trace unit is switching from one channel to the next, set the CRT Cathode Selector switch to the UPPER BEAM CHOPPED BLANKING (or LOWER BEAM CHOPPED BLANKING) position. As mentioned previously, use single-channel or external triggering for best results. When not using chopped mode operation, be sure to return the CRT Cathode Selector switch to the EXT CRT CATHODE position.

Multi-Trace Operation Using Interconnected Vertical Deflection Systems

When the Upper Beam DISPLAY switch is set to the RIGHT PLUG-IN A position and the right plug-in unit is set for alternate mode operation, the oscilloscope logic circuitry permits the signal in one channel to be displayed by both sweeps before the next channel can be displayed. To accomplish this, th logic circuitry supplies only one alternate-trace sync pulse for both sweeps. The logic circuit operates best when the B sweep is set to run at the same rate or faster than the A sweep.

NOTE

If different triggering sources are used to trigger the sweeps, the higher repetition-rate triggers should be applied to the B sweep when the B sweep is set to run faster than the A sweep.

Operating Hints (When Upper Beam DISPLAY switch is set to RIGHT PLUG-IN A)

1. If the B MODE switch is set to NORM, the B Triggering MODE switch is set to TRIG and the B sweep is not triggered, the A sweep will lock out and cannot be triggered. No displays can be obtained until the B sweep is triggered or the B Triggering MODE switch is set to AUTO STABILITY. If the B MODE switch is set to SINGLE SWEEP, the B sweep cannot be triggered until the RESET button is pressed.

2. If the B MODE switch is set to DLY'D BY A and the right plug in is set for alternate-mode operation, proper operation can be obtained if the DELAY-TIME MULTIPLIER control is set to any setting higher than 0.20 and the A and B Triggering controls are set as follows: RIGHT, INT NORM or INT PLUG IN, AC LF REJ, AUTO STABILITY: A LEVEL is set to trigger the A sweep, and B LEVEL is set fully clockwise.

If other control setting combinations are used, it is possible to obtain results that appear abnormal. Such apparent abnormal results might be: A or B sweep locks out, both sweeps lock out, shortened sweep lengths due to the sweeps reverting before completing their runup, only one channel displayed by each beam, unstable displays, etc.

BASIC APPLICATIONS

The following information describes the procedure and technique for making basic measurements with the Type 556 Oscilloscope. There can be many variations of these applications but to describe clearly how a certain basic measurement is made, the procedures give the pertinent control settings and connectors used for both the oscilloscope and the plug in(s). For these applications, therefore, assume that two Type 1A1 Dual-Trace Plug-In Units are used with the oscilloscope.

Familiarity with the operation of the instrument when used with the Type 1A1 or other similar plug-in units will permit these basic techniques to be adapted to the individual measurement requirements. As an aid to understanding how the oscilloscope operates internally, refer to Figs. 3-1 through 3-6 in the Circuit Description section. These illustrations are simplified functional block diagrams of the vertical and horizontal deflection systems.

Peak-to Peak Measurements—AC

To make a peak-to-peak voltage measurement, the Lower Beam and the right-side plug-in unit are used as an example in the following procedure:

1. Set the Lower Beam DISPLAY switch to RIGHT PLUG-IN B.

2. Preset the Type 1A1 Channel 1 VOLTS/CM switch to a deflection factor which will allow the expected signal to be displayed without over-driving the vertical amplifier.

3. Set the Type 1A1 Input Selector switch to AC.

4. Apply the signal to the Type 1A1 Channel 1 Input connector.

5. Set the Channel 1 Volts/cm switch so the signal waveform is visible in the Lower Beam graticule viewing area.

6. Set the B Triggering controls as follows:

LEVEL	Near O
MODE	AUTO STABILITY
SLOPE	+
COUPLING	AC
SOURCE	NORM INT RIGHT

7. Adjust the Channel 1 Vertical Position control so the downward excursion of the waveform coincides with one of the graticule lines below the Lower Beam graticule center line.

8. With the Lower Beam POSITION control, move the display horizontally so that one of the upper peaks of the signal lies near the vertical center line.

NOTE

The B Triggering LEVEL control and SLOPE switch can be used to horizontally position a slow rise and fall waveform such as the sine wave shown in Fig. 2-14.

9. Measure the peak-to-peak vertical deflection in cm. Make sure the Channel 1 Variable control is in the Calibrated position.

NOTE

This technique may also be used to make vertical measurements between two points on the waveform rather than peak to peak.

10. Multiply the distance measured in step 9 by the vertical attenuator switch setting. Also include the attenuation factor of the probe, if any.

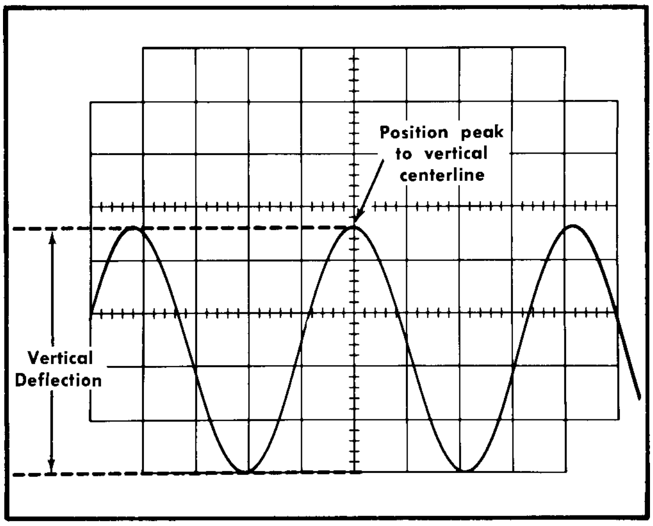


Fig. 2-14. Measuring peak-to-peak voltage of a waveform.

Example. Assume a peak-to-peak vertical deflection of 4.6 cm (see Fig. 2-14) using a 10× attenuator probe and a vertical deflection factor of 0.5 volts per cm.
Using the formula:

$$\text{Volts Peak to Peak} = \begin{matrix}\text{vertical}\\\text{deflection}\\\text{(in cm)}\end{matrix} \times \begin{matrix}\text{volts/cm}\\\text{factor}\end{matrix} \times \begin{matrix}\text{probe}\\\text{attenuation}\\\text{factor}\end{matrix}$$

Substituting the given values:

$$\text{Volts Peak to Peak} = 4.6 \times 0.5 \times 10 = 23 \text{ volts.}$$

Instantaneous Voltage Measurements—DC

To measure the DC level at a given point on a waveform, the following procedure uses the Lower Beam and the right-side plug-in unit as an example:

1. Set the Lower Beam DISPLAY switch to RIGHT PLUG-IN B.

2. Preset the Type 1A1 Channel 1 Volts/cm switch to a deflection factor which will allow the expected signal and DC component to be displayed without over-driving the vertical amplifier.

3. Set the vertical plug-in Input Selector switch to Ground.

4. Set the A Triggering MODE switch to AUTO STABILITY and turn the LEVEL control fully clockwise.

5. Position the trace to a line of the graticule below the Lower Beam graticule center line. If the average signal voltage is negative with respect to ground, position the trace to a reference line above the Lower Beam graticule center line. Do not move the vertical plug-in Position control after this reference line has been established.

NOTE

To measure a voltage level with respect to a voltage other than ground, make the following changes in step 5: set the plug-in Input Selector switch to DC, apply the reference voltage to the Input connector, and position the trace to the reference line.

6. Set the Input Selector switch to DC. The ground reference line, if used, can be checked at any time by switching to the ground position.

7. Connect the signal to the Input connector.

8. If the waveform is outside the viewing area, set the plug-in vertical attenuation switch so the waveform is visible.

9. Set the B Triggering controls for a stable display, and set the B TIME/CM controls to display the desired waveform.

10. Measure the distance in cm between the reference line and the point on the waveform at which the DC level is to be measured. For example, in Fig. 2-15 the measurement is made between the reference line and point A.

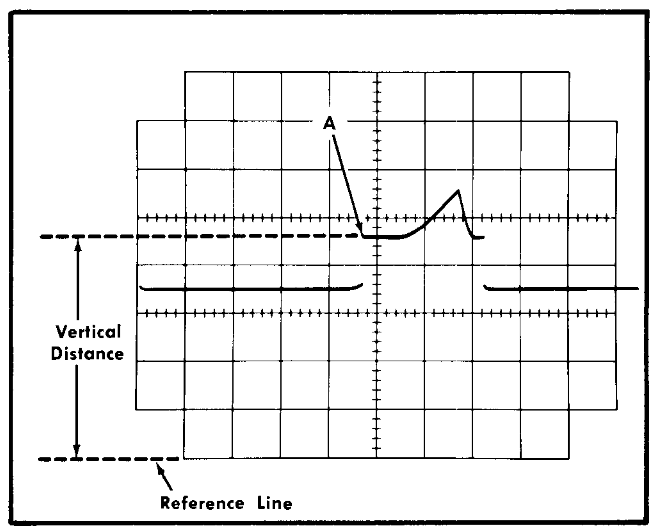


Fig. 2-15. Measuring Instantaneous DC voltage with respect to a reference.

11. Establish the polarity of the signal. Any signal-inverting switches on the plug in must be in the Normal position. If the waveform is above the reference line, the voltage is positive; below the line, negative.

12. Multiply the distance measured in step 10 by the vertical attenuation switch setting. Include the attenuation factor of the probe, if any.

Example. Assume that the vertical distance measured is 4.6 cm (see Fig. 2-15). The waveform is above the reference line, using a 10X attenuator probe and an attenuator setting of 2 volts per cm.

Using the formula:

$$\text{Instantaneous Voltage} = \text{vertical distance (in cm)} \times \text{polarity} \times \text{volts/cm setting} \times \text{probe attenuation factor}$$

$$\text{Instantaneous Voltage} = 4.6 \times +1 \times 2 \times 10$$

The instantaneous voltage is +92 volts.

Voltage Comparison Measurements

In some applications it may be necessary to establish a set of deflection factors other than those indicated by the vertical attenuator switch. This is useful for comparing signals to a reference voltage amplitude. To establish a new set of deflection factors based upon a specific reference amplitude, the Lower Beam and the right plug-in unit is used as an example in the following procedure:

1. Preset the Type 1A1 Channel 1 Volts/cm switch to a deflection factor which will allow a signal of known value to be displayed within the graticule area.

2. Set the Lower Beam DISPLAY switch to RIGHT PLUG-IN B.

3. Apply the reference signal of known value to the Channel 1 Input connector.

4. With the Channel 1 Volts/cm switch and Variable control, adjust the display for an exact number of vertical cm divisions. Do not move the Variable control after obtaining the desired deflection.

5. Divide the amplitude of the reference signal (volts) by the product of the deflection in cm (established in step 4) and the vertical attenuator switch setting. This is the Deflection Conversion Factor.

$$\text{Deflection Conversion Factor} = \frac{\text{reference signal amplitude (volts)}}{\text{deflection(cm)} \times \text{attenuator switch setting}}$$

6. To establish an Adjusted Deflection Factor at any setting of the vertical attenuation switch, multiply the attenuation switch setting by the Deflection Conversion Factor established in step 5.

$$\text{Adjusted Deflection Factor} = \text{attenuator switch setting} \times \text{Deflection Conversion Factor}$$

This adjusted Deflection Factor applies only to the right plug-in channel used and is correct only if the Variable vertical position control is not moved from the position set in step 4.

7. To determine the peak-to-peak amplitude of a signal compared to a reference, disconnect the reference and set the vertical attenuation switch to a deflection factor which will provide sufficient deflection to make the measurement. Do not move the vertical deflection Variable control.

8. Apply the signal to the Input connector, and measure the deflection. The amplitude may be determined by the following formula:

$$\text{Signal Amplitude} = \text{Adjusted Deflection Factor} \times \text{deflection (in cm)}$$

Example: Assume a reference signal amplitude of 30 volts, a vertical attenuator switch setting of 5, and a deflection of 4 cm. Substituting these values in the Deflection Conversion Factor formula (step 5):

$$\text{Deflection Conversion Factor} = \frac{30}{4 \times 5} = 1.5$$

Then, with an attenuator switch setting of 10, the Adjusted Deflection Factor (step 6) would be:

$$\text{Adjusted Deflection Factor} = 10 \times 1.5 = 15 \text{ volts/cm}$$

To determine the peak-to-peak amplitude of an applied signal which produces a vertical deflection of 5 cm, use the Signal Amplitude formula (step 8):

$$\text{Signal Amplitude} = 15 \times 5 = 75 \text{ volts.}$$

Time Measurements

A. To measure time between two points on a waveform, the Lower Beam and the right plug-in unit are used as an example in the following procedure:

1. Preset the Type 1A1 Channel Volts/cm switch to a deflection factor which will permit the signal to be displayed without over-driving the vertical amplifier.

2. Set the Lower Beam DISPLAY switch to RIGHT PLUG-IN B.

3. Connect the signal to the Input connector of Channel 1.

4. Set the Volts/cm switch to display approximately 5 vertical cm of the signal.

5. Set the B Triggering controls to obtain a stable display.

6. Set the B TIME/CM switch to the fastest sweep rate that will display less than eight divisions between the desired time measurement points (see Fig. 2-16). See the topic entitled Selecting Sweep Rate in this section concerning the non-linearity of the first and last divisions of display.

7. Adjust the Vertical Position control to move the points between which the measurement is to be made to the Lower Beam graticule center line. This location of the waveform is desirable to permit accurate measurements using the 2-mm markings of the center line.

8. Adjust the Horizontal Position control to move the starting point of the time measurement area to the first-cm graticule line.

NOTE

The B Triggering LEVEL control and SLOPE switch can be used for horizontally positioning the waveform as explained previously.

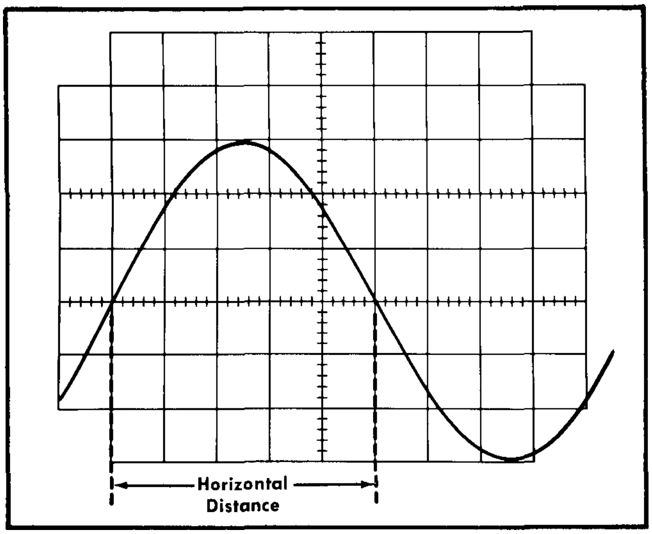


Fig. 2-16. Measuring time duration between two points on a waveform.

9. Measure the horizontal distance between the time measurement points. The B TIME/CM VARIABLE control must be in the CALIBRATED position.

10. Multiply the distance measured in step 9 by the setting of the B TIME/CM switch. If sweep magnification is used, divide the result by 10.

Example: Assume that the distance between the time measurement points is 5 cm (see Fig. 2-16) and the B TIME/CM switch is set to .1 mSEC with the magnifier off.

Using the formula:

$$\text{Time Duration} = \frac{\text{horizontal distance (in cm)} \times \text{TIME/CM setting}}{\text{magnification}}$$

Substituting the given values:

$$\text{Time Duration} = \frac{5 \times 0.1 \text{ mS}}{1}$$

The time duration is 0.5 milliseconds.

B. Time measurements between two time-related events may be made using a Dual-Trace plug-in such as the Type 1A1 and a single beam display of the Type 556.

To simplify procedure steps, assume that the Lower Beam will display Channels 1 and 2 of the right plug-in. Use the following procedure:

1. Set the Lower Beam DISPLAY switch to RIGHT PLUG-IN B.

2. Set the B Triggering controls for right plug-in internal triggering.

3. Preset the right plug-in Channel 1 and 2 Volts/cm switches for a deflection factor which will permit displays without over-driving the vertical amplifier.

4. Set the right plug-in Mode switch either to Chop or Alt. In general, the Chopped mode is more suitable for low-frequency signals, and the Alternate mode is more suitable for high-frequency signals. More information on determining the correct mode is given under Multi-Trace Operation in this section.

5. Connect the reference signal to the Channel 1 input and the comparison signal to the Channel 2 input. The reference signal should precede the comparison signal in time. Use coaxial cables or probes which have equal time-delay characteristics to connect the signals to the input connectors.

6. Set both Volts/cm switches to display 4 or 5 vertical cm of the reference signal and the comparison signal.

7. Obtain a stable display with the B Triggering LEVEL control.

8. Set the B TIME/CM switch for a sweep rate which shows as much distance as possible (up to 8 cm) between the two waveforms.

9. Adjust the Vertical Position controls of Channels 1 and 2 to center the points on each waveform between which the measurement is to be made on the Lower Beam center line.

10. Adjust the Horizontal POSITION control so the Channel 1 (reference) waveform crosses the horizontal center line at a vertical graticule line.

11. Measure the horizontal difference between the Channel 1 wavveform and the Channel 2 waveform (see Fig. 2-17).

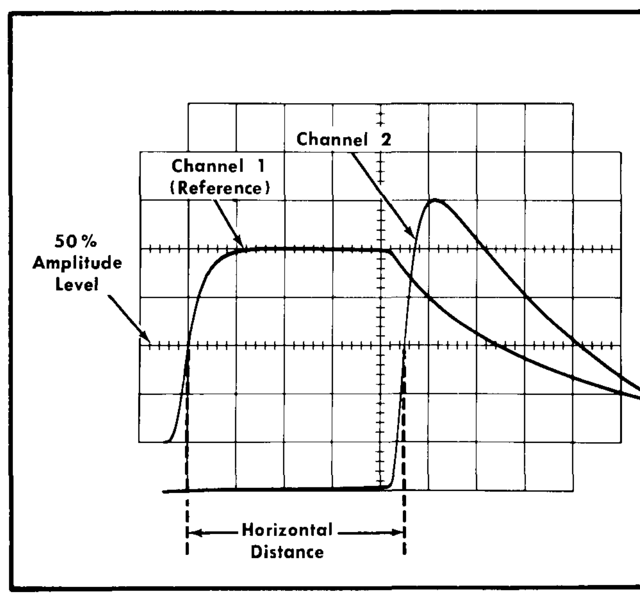


Fig. 2-17. Measuring the time difference between two pulses using a dual-trace unit and a single beam.

12. Multiply the measured difference by the setting of the B TIME/CM switch. If sweep magification is used, divide the answer by 10.

Example: Assume that the TIME/CM switch setting is 50 μSEC, the DISPLAY MAG is set to $\times$10 and the horizontal difference between waveforms is 4.5 cm (see Fig. 2-17).
Using the formula:

$$\text{Time Delay} = \frac{\text{TIME/CM setting} \times \text{horizontal difference (in cm)}}{\text{magnification}}$$

Substituting the given values:

$$\text{Time Delay} = \frac{50 \times 4.5}{10}$$

The time delay is 22.5 microseconds.

C. Time-comparison measurements may also be made using both beams of the Type 556 and two single-channel vertical plug-ins. Time-related events can be displayed by both beams if the beams are both driven at the same sweep rate. It is generally advisable to use the same time base for driving both beams to reduce the overall error resulting from sweep rate tolerances.

Use the following procedure:

1. Set the AMPLITUDE CALIBRATOR switch to .1 VOLTS, the B TIME/CM switch to .5 mSEC, the Lower Beam DISPLAY switch to RIGHT PLUG-IN B, and both plug-in Vertical Attenuator switches to 0.05 volts/cm.

2. Set the Upper Beam DISPLAY switch to LEFT PLUG-IN B. Both beams will be used (in step 3 and following) to display two separate input signals on the same time base, and the A TIME/CM switch will have no effect on the Upper Beam display.

3. Connect the Calibrator signal to both Vertical Inputs and set the B Triggering controls so both displays are stable while triggering on the positive slope of the waveform.

4. With the two plug-in Vertical Position controls, superimpose the waveforms and position the 50% amplitude levels to one of the beam graticule center lines.

5. Adjust the Upper Beam and Lower Beam Horizontal POSITION controls so the rising portion at the start of each trace begins on the second vertical (1-cm) graticule line. Do not move either Horizontal POSITION control after the beams are thus registered.

6. Remove the Calibrator signal from the two Input connectors and connect the two time-related signals to be displayed. If necessary reset the plug-in vertical deflection factors so the displays do not overscan the viewing area and repeat step 4.

NOTE

Since both Upper and Lower Beam displays are initiated by the input signal from the right plug in, it will be necessary to connect the first (reference) signal to the right plug-in Input connector. Also the two signals to be compared should be connected to the two plug-in connectors by cables or probes having the same delay characteristics.

Time-interval measurements can now be made. See Fig. 2-18.

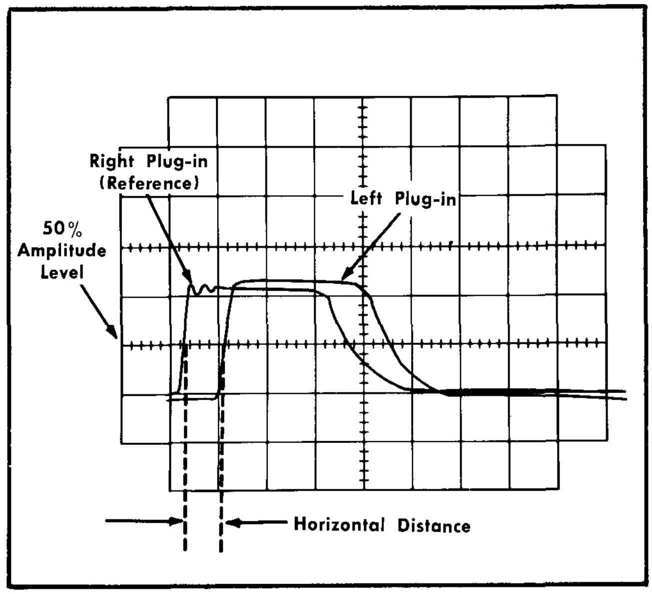


Fig. 2-18. Measuring the time difference between two pulses using single-channel units, both beams and the same time base.

Delayed Sweep Time Measurements

The delayed sweep mode can be used to make accurate time measurements. Overall accuracy of the measurement will be affected by the following factors:

a. Accuracy of the A Sweep Generator at the sweep rate used.

b. DELAY-TIME MULTIPLIER dial incremental accuracy.

The following measurement determines the time difference between two pulses displayed on the same trace. This application may also be used to measure time difference from two different sources (dual-trace) or to measure time duration of a single pulse.

1. Preset the plug-in vertical deflection factor to permit an on-screen display of the waveform to be measured.

2. Apply the signal to the right vertical plug-in unit.

3. Set the Upper Beam DISPLAY switch to RIGHT PLUG-IN A and the Lower Beam DISPLAY switch to RIGHT PLUG-IN B.

4. Set the B TIME/CM switch for a sweep rate about 10 times faster than that of the A TIME/CM switch.

5. Set the B MODE switch to DLY'D BY A. (Leave the A MODE switch set to NORM).

6. Set the DELAY-TIME MULTIPLIER control for a dial reading between 1.00 and 9.50.

7. Set the A Triggering controls for normal internal triggering on the right plug-in signal.

8. Set these B Triggering controls as follows:

LEVEL	Fully clockwise and knob pulled outward
MODE	AUTO STABILITY

9. The Upper Beam display should have an intensified portion indicating the delayed B sweep time duration. If necessary, adjust the CONTRAST control to show clearly the difference between the unintensified and intensified portions.

The Lower Beam should show a magnified display of the intensified portion of the Upper Beam display.

10. Turn the DELAY-TIME MULTIPLIER dial to move the intensified portion of the Upper Beam display to the first pulse so the first dial reading can be obtained. The exact point may be determined by positioning the magnified pulse (or the rising portion) to the vertical center line of the graticule, as viewed on the Lower Beam trace (see Fig. 2-19A). Note the reading on the DELAY-TIME MULTIPLIER dial.

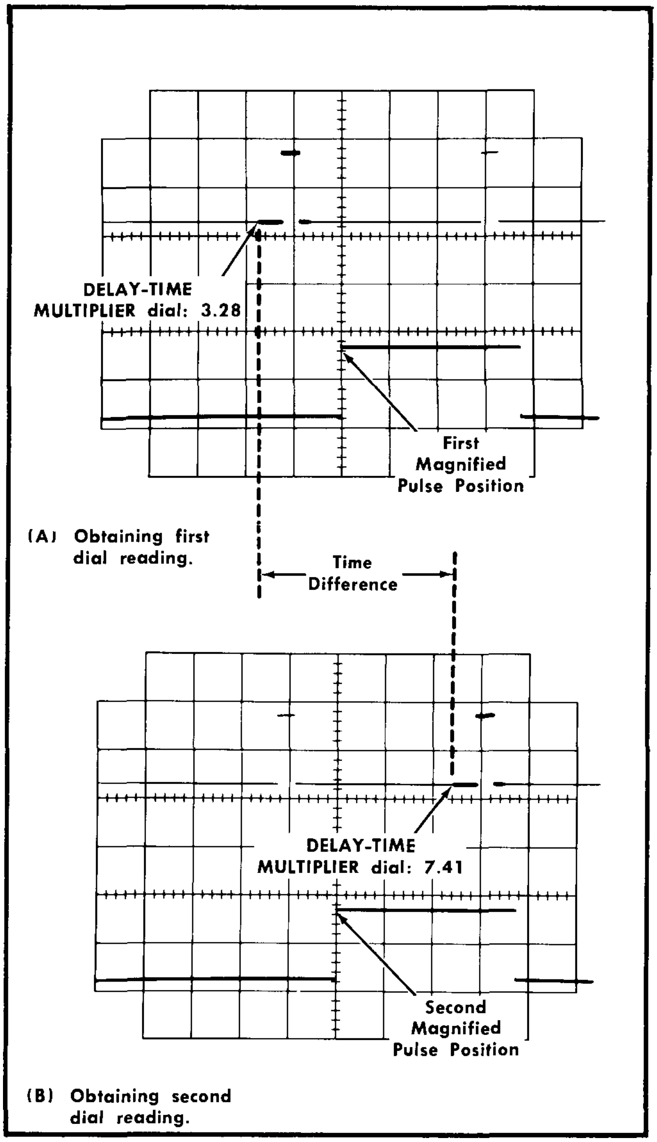


Fig. 2-19. Measuring time difference using delayed sweep.

11. Advance the intensified portion of the display to the next pulse (see Fig. 2-19B), determining the exact position as in step 10. Note the reading on the DELAY-TIME MULTIPLIER dial.

12. Subtract the first reading from the second and multiply by the setting of the A TIME/CM switch. This is the time interval between the pulses.

Example: Assume the first dial reading is 3.28 and the second dial reading is 7.41 with the A TIME/CM switch set to 2 mSEC (see Fig. 2-17).

Using the formula:

$$\text{Time Difference (delayed sweep)} = \left(\text{second dial reading} - \text{first dial reading}\right) \times \text{A TIME/CM setting}$$

Substituting the given values:

$$\text{Time Difference} = (7.41 - 3.28) \times 2.$$

The time difference is 8.26 milliseconds.

13. If all possible tolerances are included, the formula should read:

$$\text{Time Difference} = \left(\text{2nd dial reading} - \text{1st dial reading}\right) 1 \pm 0.01 \quad \pm 0.04^{1} \times \text{A TIME/CM setting}$$

[1] **±0.07 for 3 fastest A TIME/CM readings**

Delayed Sweep Magnification

The delayed sweep feature can be used to provide widerrange magnification than can be obtained by the use of the DISPLAY MAG switch position. The rate of either sweep is not actually increased; the magnification is the result of delaying the B sweep an amount of time selected by the A TIME/CM switch and the DELAY-TIME MULTIPLIER dial before the display is presented at the sweep rate selected by the B TIME/CM switch. At higher magification ranges, the Triggered Delayed Sweep Magnification procedure should be used.

For delayed sweep magification, use the following procedure:

1. Preset the right plug-in vertical deflection factor for an on-screen display.

2. Set the B Triggering MODE switch to AUTO STABILITY, turn the LEVEL control fully clockwise and pull the LEVEL knob outward.

3. Set the Upper Beam DISPLAY switch to RIGHT PLUG-IN A.

4. Apply the signal to the Input connector of the right plug in.

5. Set the A Triggering controls for a stable display on the Upper Beam (SOURCE switch set to RIGHT).

6. Set the B MODE switch to DLY'D BY A.

7. Set the A TIME/CM switch to a setting which displays the complete waveform, and set the B TIME/CM switch to a setting 100 times faster. The Upper Beam display should show the complete waveform with an intensified portion. This intensified portion has a duration equal to the ratio of the B TIME/CM setting to the A TIME/CM setting, and is displayed on the Lower Beam in magnified form.

NOTE

It may be necessary to adjust the front panel CONTRAST control in order to view the intensified portion of the Upper Beam display more easily.

8. The magnification can be calculated by dividing the A TIME/CM setting by the B TIME/CM setting.

Example: The magnification of the display shown in Fig. 2-20 with an A TIME/CM setting of 10 μSEC and a B TIME/CM setting of .1 μSEC is:

$$\text{Magnification} = \frac{10 \times 10^{-6}}{.1 \times 10^{-6}} = 100$$

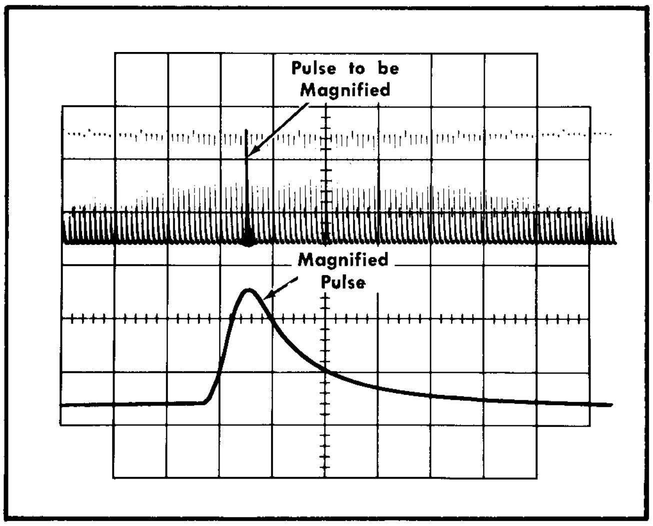


Fig. 2-20. Using delayed sweep for sweep magnification.

The magnification is 100 times.

The delayed sweep magnification method just described may produce too much jitter at high magnification ranges. Displaying the delayed sweep in a triggered mode provides a more stable display, since the delayed display is triggered at the same point each time. For a triggered delayed sweep display, use the following procedure:

1. Set up the display as given in steps 1 through 7 in the Delayed Sweep Magnification section.

2. With the DELAY-TIME MULTIPLIER dial, move a waveform peak of the magnified display to the vertical center line of the graticule.

3. Push the B Triggering LEVEL knob in and rotate the control slowly counterclockwise. At a point near the O mark, the waveform peak on the magnified display will jump to the start of the B sweep, indicating that the B sweep is now triggered. Notice that rotation of the DELAY-TIME MULTIPLIER dial will cause the intensified portion of the Upper Beam display to jump from one peak to the next, while the delayed sweep display remains stable.

4. Measurement and magnification are as described under Delayed Sweep Magnification.

Displaying Complex Signals Using Delayed Sweep

Complex signals often consist of a number of individual events of differing amplitudes. Since the trigger circuits are sensitive to changes in signal amplitude, a stable display can normally be obtained only when the sweep is triggered by the event(s) having the greatest amplitude. However, this may not produce the desired display of a lower amplitude event which follows the triggering event. The delayed sweep feature provides a means of delaying the start of the B sweep by a selected amount following the event which triggers the A Sweep Generator. Then, the part of the waveform which contains the information of interest can be displayed. Fig. 2-21 demonstrates this feature. Follow the operation under Delayed Sweep Magnification or Triggered Delayed Sweep Magnification to obtain a display in this mode.

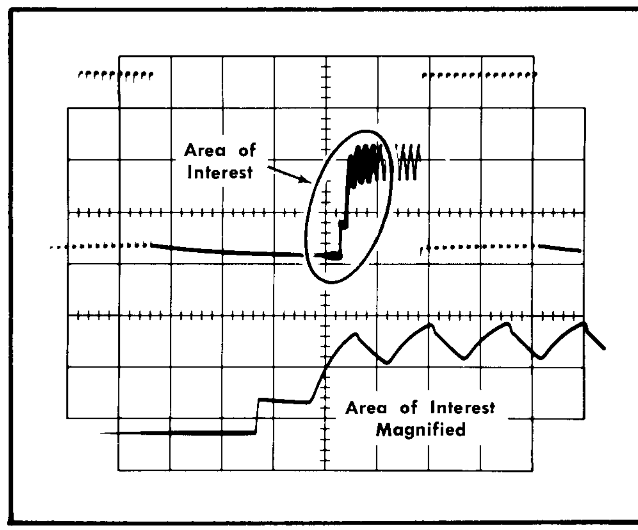


Fig. 2-21. Displaying a complex signal using delayed sweep.

Frequency Measurements

The frequency of a periodically-recurrent waveform can be determined as follows:

1. Measure the time duration of one cycle of the waveform as described in Time Measurements, step A.

2. The frequency of the signal is the reciprocal of the time duration of one cycle.

Example: The frequency of the signal shown in Fig. 2-22 which has a time duration of 1 ms is:

$$\text{Frequency} = \frac{1}{.001} = 1{,}000 \text{ or } 1 \text{ kHz}$$

Risetime Measurements

Risetime measurements employ basically the same techniques as time-duration measurements. The main difference is in the points between which the measurement is made. The following procedure gives the basic method of measuring risetime between the 10% and 90% points of the waveform.

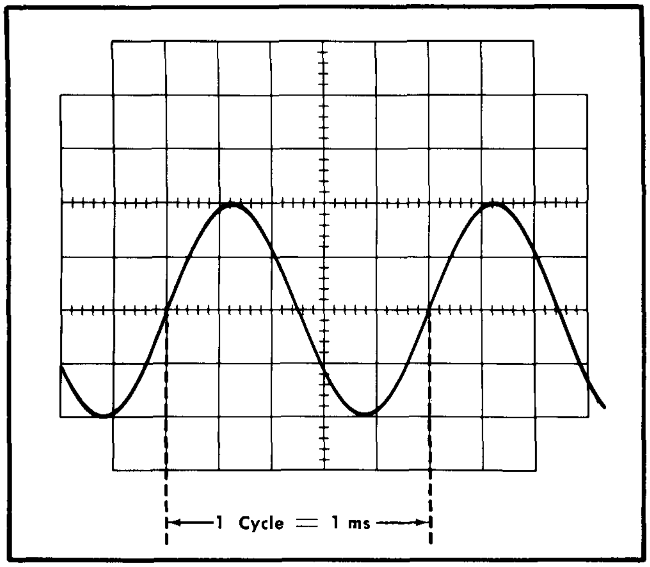


Fig. 2-22. Determining the frequency of a periodically recurrent waveform when the TIME/CM switch is set to .2 mSEC.

Falltime can be measured in the same manner on the trailing edge of the waveform.

1. Set the Lower Beam DISPLAY switch to RIGHT PLUG-IN B.

2. Preset the Type 1A1 Channel 1 Volts/cm switch to a deflection factor which will allow the expected signal to be displayed without overdriving the vertical amplifier.

3. Apply the signal to the Channel 1 Input connector.

4. Set the Volts/cm switch and Variable control to produce a display an exact number of divisions in amplitude.

5. Center the display about the horizontal center line of the Lower Beam graticule area.

6. Set the B TIME/CM switch to the fastest sweep rate that will display less than eight divisions between the 10% and 90% points on the waveform. The TIME/CM VARIABLE control must be in the CALIBRATED position.

7. Determine the 10% and 90% points on the rising portion of the waveform. The figures given in Table 2-3 are for the points 10% up from the start of the rising portion and 10% down from the top of the rising portion (90% point).

TABLE 2-3

Vertical Display (cm)	10% and 90% points
4	0.4 cm
5	0.5 cm
6	0.6 cm

8. Adjust the Horizontal POSITION control to move the 10% point of the waveform to the second cm graticule line. For example, with a 5-cm vertical amplitude display as shown in Fig. 2-23, the 10% point would be 0.5 cm up from the start of the rising portion.

NOTE

If the fastest sweep speed (10 ns/cm) is used, set the Triggering LEVEL control so the rising portion of the waveform starts at the fourth cm graticule line.

9. Measure the horizontal distance between the 10% and 90% points.

10. Multiply the distance measured in step 9 by the setting of the TIME/DIV switch. If sweep magnification is used, divide this answer by 10.

Example: Assume that the horizontal distance between the 10% and 90% points is 4 cm (see Fig. 2-23) and the TIME/DIV switch is set to 1 μSEC with the DISPLAY MAG switch set to $\times 10$. Applying the time duration formula to risetime:

$$\text{Risetime (Time Duration)} = \frac{\text{horizontal distance (in cm)} \times \text{TIME/CM setting}}{\text{magnification}}$$

Substituting the given values:

$$\text{Risetime} = \frac{2 \times 1}{10} = 0.2 \text{ microsecond.}$$

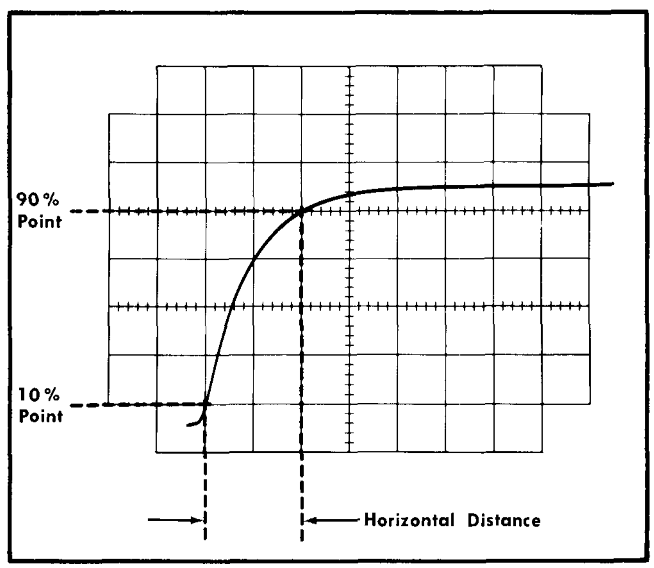


Fig. 2-23. Measuring risetime.

Delayed Trigger Generator

The B GATE output signal (available at the front-panel connector) can be used to trigger an external device at a selected delay time after the start of the A Sweep. The delay time of the B GATE output signal can be selected by the setting of the DELAY-TIME MULTIPLIER dial and A TIME/CM switch.

A Sweep Triggered Internally. When the A Sweep is triggered internally to produce a normal display, the delayed trigger may be obtained as follows:

1. Obtain a triggered display in the normal manner on the Upper Beam.

2. Set the B MODE switch to DLY'D BY A.

3. Select the amount of delay from the start of A Sweep by means of the DELAY-TIME MULTIPLIER dial, positioning the intensified portion of the Upper Beam display as desired.

4. Connect the B GATE signal to the external equipment.

5. The duration of the B GATE pulse is determined by the setting of the B TIME/CM switch.

6. The external equipment will be triggered at the start of the intensified portion if it responds to positive-going triggers, or at the end of the intensified portion if it responds to negative-going triggers.

A Sweep Triggered Externally. This mode of operation can be used to produce a delayed trigger with or without a corresponding display. Connect the external trigger signal to the A Triggering TRIGGER INPUT connector and set the A Triggering SOURCE switch to EXT. Obtain a triggered sweep of the Upper Beam. Then, follow the operation given under A Sweep Triggered Internally (steps 2 through 6) to obtain the delayed trigger.

Normal Trigger Generator

Ordinarily, the signal to be displayed also provides the trigger signal for the oscilloscope. In some instances, it may be desirable to reverse this situation and have the oscilloscope trigger the signal source. This can be done by connecting the A GATE signal to the input of the signal source. Pull the A Triggering LEVEL knob outward, rotate the LEVEL control fully clockwise, set the A Triggering MODE to AUTO STABILITY, and adjust the A TIME/CM switch for the desired display. Since the signal source is triggered by a signal that has a fixed time relationship to the sweep, the output of the signal source can be displayed on the CRT as though the Type 556 were triggered in the normal manner.

Multi-Trace Phase Difference Measurements

Phase comparison between two signals of the same frequency can be made using the dual-beam feature with single-input plug-ins. This method of phase-difference measurement can be used up to the frequency limit of the vertical system provided both the A and B horizontal amplifiers are accurately calibratetd and are identical. To make the comparison, use the following procedure:

1. Set the AMPLITUDE CALIBRATOR switch to .1 VOLTS, the B TIME/CM switch to .5 mSEC, and both plug-in vertical attenuator switches to 0.05 volts/cm.

2. Set the Lower Beam DISPLAY switch to RIGHT PLUG-IN B.

3. Set the Upper Beam DISPLAY switch to LEFT PLUG-IN B. Both beams will be used (in steps 4 and following) to display two separate input signals on the same time base, and rotation of the A TIME/CM switch will have no effect on the Upper Beam display.

4. Connect the Calibrator signal to both Vertical Inputs and set the B Triggering controls so both displays are stable while triggering on the positive slope of the waveform.

5. With the Vertical Position controls, superimpose and center the waveforms on the Lower Beam graticule center line.

6. Adjust the Upper and Lower Beam Horizontal POSITION controls so the start of each trace is on the first vertical (0-cm) graticule line. Then, if necessary, slightly readjust one of the Horizontal POSITION controls so the rising portions of the square waves are superimposed in the center area of the graticule. Do not move either Horizontal POSITION control after the beams are thus registered.

7. Remove the calibrator signal from the two Input connectors, adjust both vertical attenuator switches to a deflection factor which will display the signals to be compared, and apply the two signals to the plug-in Inputs. (If the displays are not the desired size, reset the vertical attenuator switches).

NOTE

Since both Upper and Lower Beam displays are initiated by the input signal from the right plug-in, it will be necessary to connect the first (reference) signal to the right plug-in Input connector. Also the signals to be compared should be connected to the plug-ins by means of cables or probes having the same delay characteristics.

8. With the B Triggering controls, obtain a stable display (both beams).

9. Set the B TIME/CM switch to a sweep rate which displays about one cycle of the waveform.

10. Turn the B TIME/CM VARIABLE control until one cycle of the reference signal (the right plug-in) occupies exactly 9 cm horizontally (see Fig. 2-24). Each cm then represents 40° of the cycle (360° divided by 9 cm = 40° per cm). This is the phase factor.

11. Measure the horizontal difference between corresponding points on the waveform.

12. Multiply the measured distance (in cm) by 40° (phase factor) to obtain the exact amount of phase difference.

Example: Assume a horizontal difference is 0.6 cm with a phase factor of 40° as shown in Fig. 2-24.

Using the formula:

$$\text{Phase Difference} = \begin{matrix}\text{horizontal}\\ \text{difference}\\ \text{(in cm)}\end{matrix} \times \begin{matrix}\text{phase}\\ \text{factor}\end{matrix}$$

Substituting the values given:

$$\text{Phase Difference} = 0.6 \times 40°$$

The phase difference is 24°.

More Precise Phase Measurements. More precise phase measurements can be made by increasing the sweep rate (without changing the B TIME/CM VARIABLE control setting). One of the easiest ways to increase the sweep rate is with the Lower Beam DISPLAY MAG switch. Delayed sweep magnification may also be used. The adjusted phase factor is determined by dividing the phase factor obtained previously by the increase in sweep rate.

Example: If the sweep rate were increased 10 times with the magnifier, the adjusted phase factor would be 40° divided by 10 = 4° per cm. Fig. 2-25 shows the same signals used in Fig. 2-24 but with the Lower Beam DISPLAY MAG switch set to ×10. With a horizontal difference of 6 cm, the phase difference is:

$$\text{Phase Difference} = \begin{matrix}\text{horizontal}\\ \text{difference}\\ \text{(in cm)}\end{matrix} \times \begin{matrix}\text{adjusted}\\ \text{phase}\\ \text{factor}\end{matrix}$$

Substituting the given values:

$$\text{Phase Difference} = 6 \times 4^\circ$$

The phase difference is 24°.

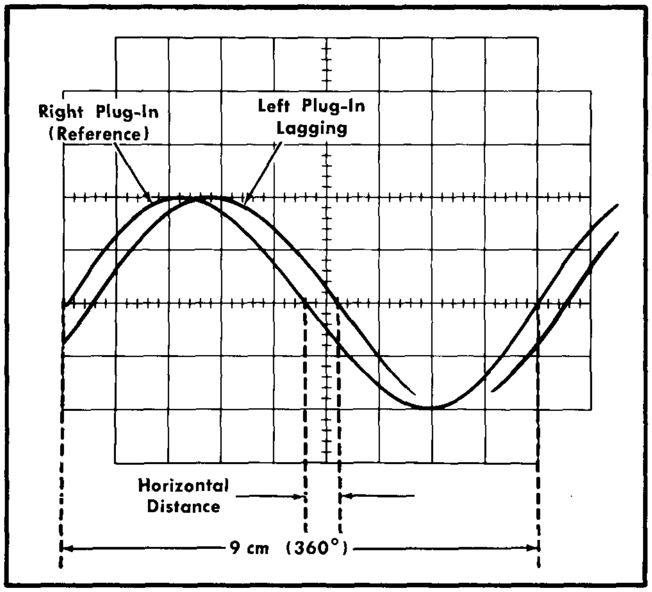


Fig. 2-24. Measuring phase difference.

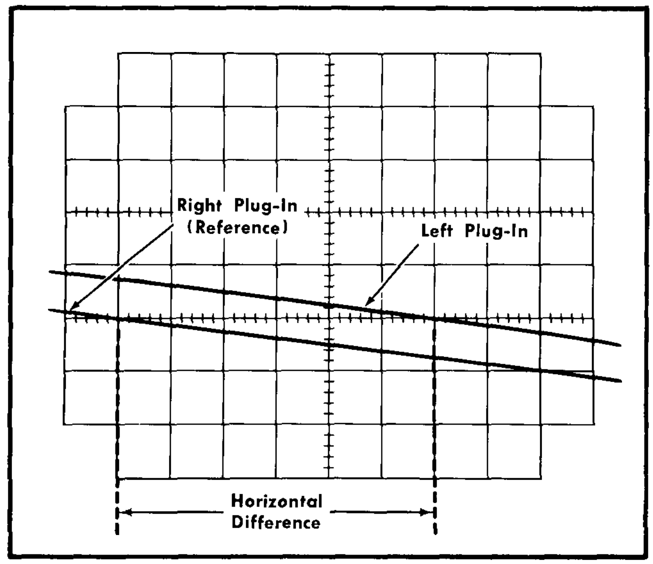


Fig. 2-25. Using a sweep magnification to measure the phase difference.

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SECTION 3
CIRCUIT DESCRIPTION

Change information, if any, affecting this section is found at the rear of the manual.

Introduction

This section of the manual contains a functional description of the instrument circuitry. A general discussion of display logic, with accompanying diagrams, preceeds the detailed functional circuit analysis.

DISPLAY LOGIC

The display logic system used to connect deflection signals to the dual independent vertical and horizontal deflection circuits provides the instrument with a versatility that permits accommodation of diverse applications. The two beams may be deflected by signals from several sources. In general, the signal source options are as follows:

Upper Beam—Vertical deflection by signals from either plug-in unit. Horizontal deflection by sweep signals from either A or B time base generator or by signals from an external source (EXT HORIZ IN).

Lower Beam—Vertical deflection by signals from the right plug-in only. Horizontal deflection by sweep signals from either A or B time base generator (Time-base B only for serial numbers 1999 and below) or by signals from an external source.

Table 3-1 lists some typical applications with examples of signal source selections. The figure number listed with an application refers to the illustration that shows the major circuit interconnections for the selected signal source opions.

FUNCTIONAL BLOCK DIAGRAMS

To provide a basis for this discussion, six functional block diagrams (Fig. 3-1 through 3-6) are used to demonstrate how the major circuit blocks are connected when a particular operating mode is set up. There are many other combinations that can be shown, depending on the setting of the controls and the plug-in units used, but these six modes are intended to provide the fundamental information needed for quickly analyzing the internal operation of the Type 556 before studying the individual circuits in detail.

First Basic Mode (Fig. 3-1)

In this mode of operation the Type 556 is operating as two completely independent systems. A signal applied to the left plug-in unit is coupled to the Left Vertical Input Amplifier. At this point a portion of the signal is taken off to provide normal internal push-pull triggering signals to the A Sweep Trigger circuit. This circuit converts the triggering of the A Sweep Generator.

With the Upper Beam DISPLAY switch set to LEFT PLUG-IN A, the sawtooth from the A Sweep Generator is applied to the Upper Beam Horizontal Amplifier. This amplifier provides push-pull drive to the Upper Beam horizontal deflection plates.

TABLE 3-1

Application	Signal Source Selection			
	Upper Beam		Lower Beam	
	Vertical	Horizontal	Vertical	Horizontal
Two indepent display systems. Fig. 3-1.	Left	A sweep	Right	B sweep
Signals from one plug-in displayed at two sweep rates. Figs. 3-2, 3-4 and 3-6.	Right	A sweep	Right	B sweep
Signals from two plug-ins displayed at a common sweep rate.	Left	B sweep	Right	B sweep
Dual X-Y displays.	Left	External	Right	External
Combined X-Y and Y-T (time-base) displays. Fig. 3-3.	Right	External	Right	B sweep
Dual multi-trace displays. Fig. 3-5.	Right	A sweep	Right	B sweep
B sweep delayed by A sweep. Fig. 3-6.	Right	A sweep	Right	B sweep

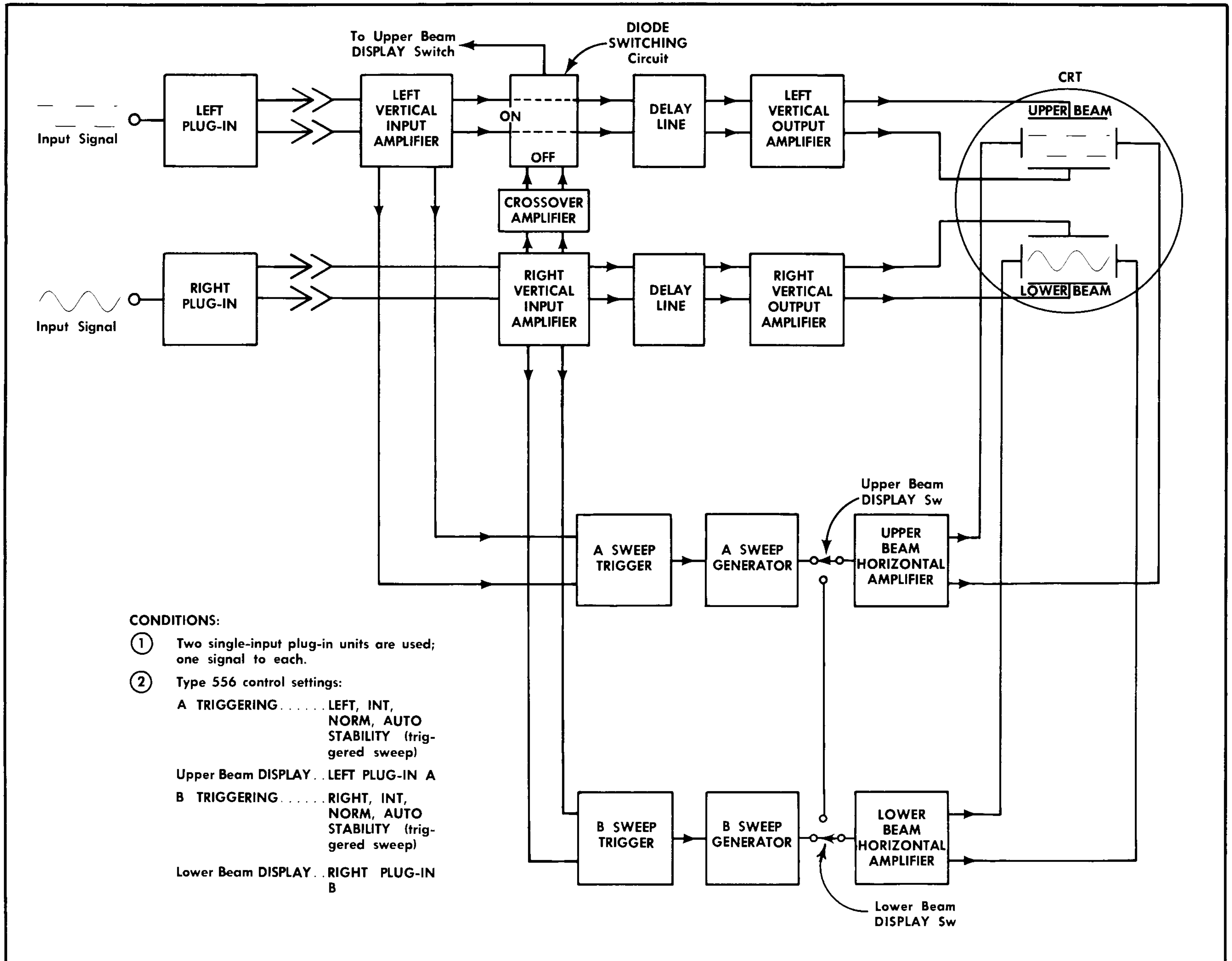

Fig. 3-1. The Type 556 operating as two completely independent deflection systems (one for each beam).

Going back to the Left Vertical Input Amplifier block, the left vertical signal is also applied to the Diode Switching circuit. With the Upper Beam DISPLAY switch set as given, the Diode Switching circuit connects the signal to the left vertical Delay Line. Any signal from the right plug-in is blocked by the "off" diodes in the Diode Switching circuit.

The Delay Line is a specially braided 186-ohm line which delays the application of the left plug-in signal to the Left Vertical Output Amplifier for 170 ns. This amount of delay provides time for unblanking the Upper Beam and starting the horizontal sweep before the vertical signal reaches the Upper Beam vertical deflection plates. Thus, it is possible to display the leading edge of a single fast-rising pulse. The Delay Line has a constant characteristic impedance along its length and requires no adjustment.

The signal applied to the right plug-in drives the Lower Beam deflection plates and B Sweep Trigger in the same manner as described for the Upper Beam system. In like manner, the B Sweep Trigger circuit triggers the B Sweep Generator. The sawtooth output is applied to the Lower Beam Horizontal Amplifier which in turn is used to drive the Lower Beam horizontal deflection plates.

Second Basic Mode (Fig. 3-2)

This mode shows the Type 556 operating as two interconnected vertical deflection systems with independent horizontal deflection systems. The main advantage of this mode is that only one probe need be used for coupling the signal to the Type 556, and yet maximum flexibility is obtained in displaying the signal on both beams. Use of one probe will minimize circuit loading of the device under test as compared to using separate probes at the same test point.

The vertical signal to be displayed by both beams is applied to the right plug-in. At the Right Vertical Input Amplifier the signal is taken off in the usual manner for application to the A and B Sweep Trigger circuits. The trigger circuits trigger their respective Sweep Generator circuits. The A Sweep Generator and Upper Beam Horizontal Amplifier circuits drive the Upper Beam horizontal deflection plates. Similarly, the B Sweep Generator and Lower Beam Horizontal Amplifier circuits drive the Lower Beam horizontal deflection plates. The sweep rate for the one beam can be controlled independent of the other. Thus, the displays shown in Fig. 3-2, for example, can be obtained by setting one sweep rate twice as fast as the other.

Also, from the Right Vertical Input Amplifier the signal goes through a Crossover Amplifier to the Diode Switching circuit. With the Upper Beam DISPLAY switch set to RIGHT PLUG-IN A, the diodes for the right plug-in signal are turned on and the signal goes through the left vertical Delay Line and Left Vertical Output Amplifier to the Upper Beam vertical deflection plates. The signal from the left plug-in is blocked by the "off" diodes in the Diode Switching circuit.

To provide a vertical display on the Lower Beam, the right plug-in signal goes through the Right Vertical Input Amplifier, right vertical Delay Line and Right Vertical Output Amplifier to the Lower Beam vertical deflection plates.

Since the left plug-in is not used in this mode for display purposes, it can be used to amplify a low-amplitude triggering signal for application to the A and B Sweep Trigger circuits. To use this trigger, set the A and B Triggering SOURCE switches to LEFT, INT, NORM.

Third Basic Mode (Fig. 3-3)

Under the conditions given in Fig. 3-3, the Type 556 is operating as two interconnected vertical systems and two independent horizontal deflection systems. In this mode, however, the Upper Beam Horizontal Amplifier is driven externally to obtain an Upper Beam X-Y display of the right plug-in and external horizontal input signals. The Lower Beam is used in a conventional manner to display the right plug-in signal amplitude against time.

Since the A Sweep Trigger and A Sweep Generator circuits are not used to obtain the displays, these circuits can be used for other purposes, if desired. For example, the A Sweep Generator block shows that its output signals are available. In addition, the left plug-in and Left Vertical Input Amplifier blocks are available for other uses as mentioned in the Second Basic Mode description.

Fourth Basic Mode (Fig. 3-4)

Fig. 3-4 shows the Type 556 operating as two interconnected vertical and horizontal deflection systems. Here the right plug-in signal is applied to the vertical deflection plates of both beams and the B Sweep circuit is used to provide dual-beam horizontal deflection.

Horizontal deflection of the beams can be controlled individually by using the DISPLAY MAG switches. To obtain the displays shown, the Upper Beam DISPLAY MAG switch is set to $\times 1$ and the Lower Beam DISPLAY MAG switch is set to $\times 10$.

As described previously, the blocks that are not used for obtaining the displays can be used for other purposes.

Fifth Basic Mode (Fig. 3-5)

In this mode of operation the Type 556 is operating as two interconnected vertical deflection systems. The dual-trace right plug-in unit provides the vertical deflection for both beams. Both Sweep Generators and Horizontal Amplifiers provide independent horizontal deflection drive for their respective beams.

With the dual-trace unit operating in the alternate mode, the Alternate Trace Logic circuit is used to produce one alternate sync pulse per slower sweep. For example, assume that both Sweep Generators are triggered simultaneously by the right plug-in channel 1 signal and both sweeps have started. Also, assume that the A Sweep is set to run several times slower than B Sweep. Under these conditions, the B Sweep Generator will generate several sweeps while the A Sweep is still running up. But, each time the B Sweep resets no alternate sync pulses are produced during the A Sweep runup.

As soon as the A Sweep ends, however, the A Sweep Inhibit gate keeps the A Sweep from starting again until the B Sweep can reset once again. As the B Sweep resets, the combined condition of A Sweep off and B Sweep resetting causes the Alternate Trace circuit to produce one alternate sync pulse that is applied to the dual-trace unit. The

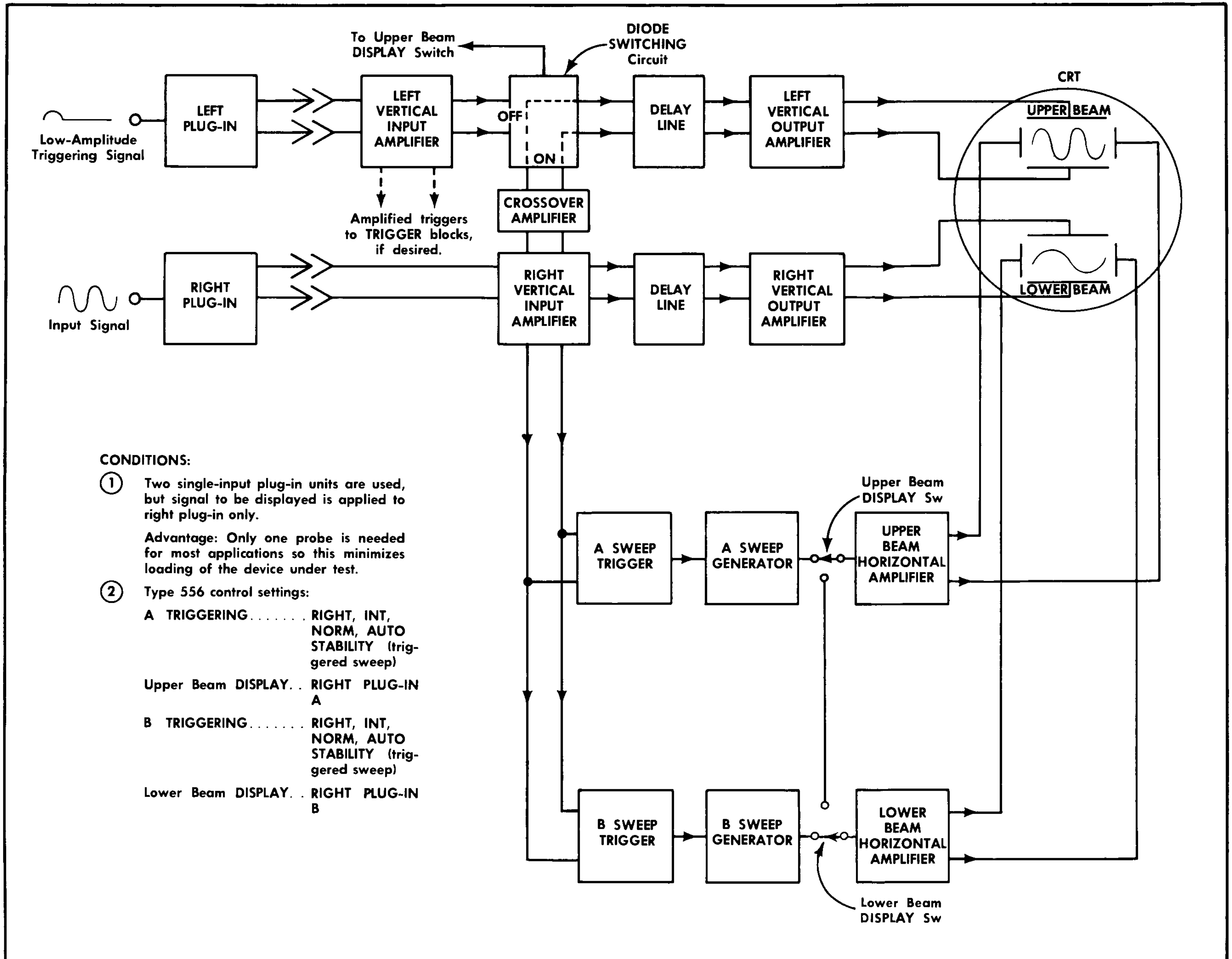

Fig. 3-2. The Type 556 operating as two interconnected vertical deflection systems and two completely independent horizontal deflection systems.

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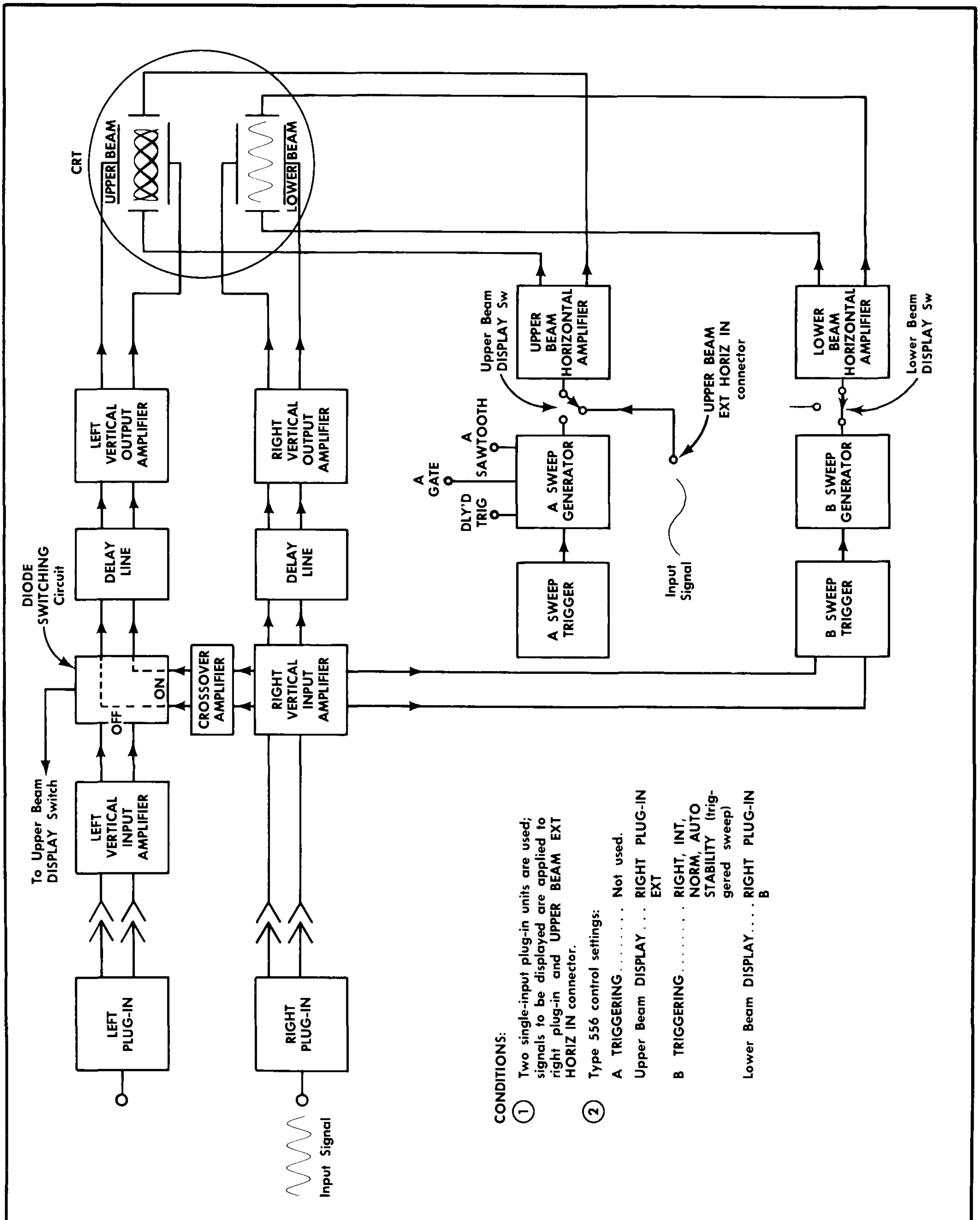

Fig. 3-3. The Type 556 operating as two interconnected vertical deflection systems and two completely independent horizontal deflection systems. Upper Beam Horizontal Amplifier is driven externally to obtain an X-Y display and the Lower Beam is driven by the B Sweep.

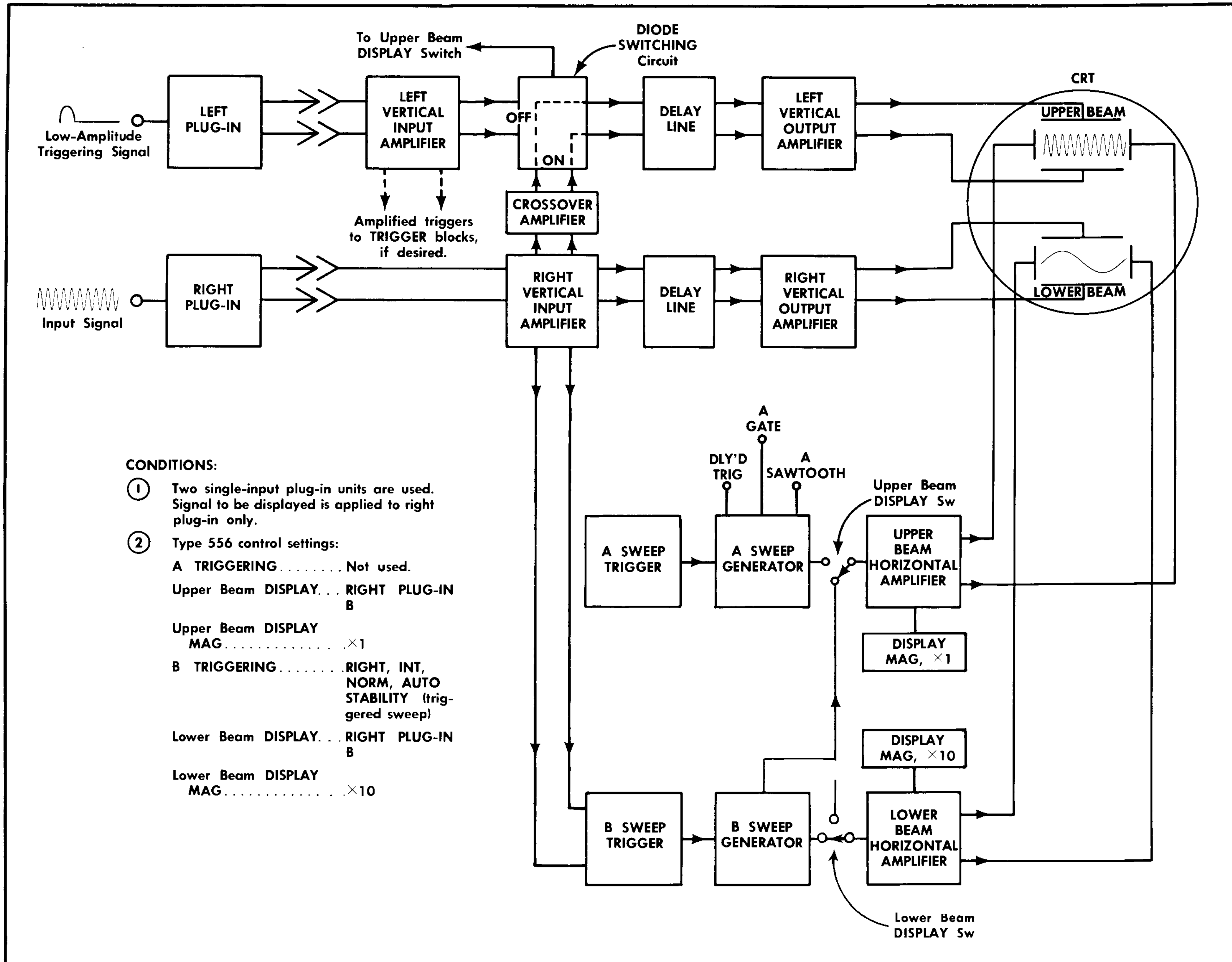

Fig. 3-4. The Type 556 operating as two interconnected vertical and horizontal deflection systems.

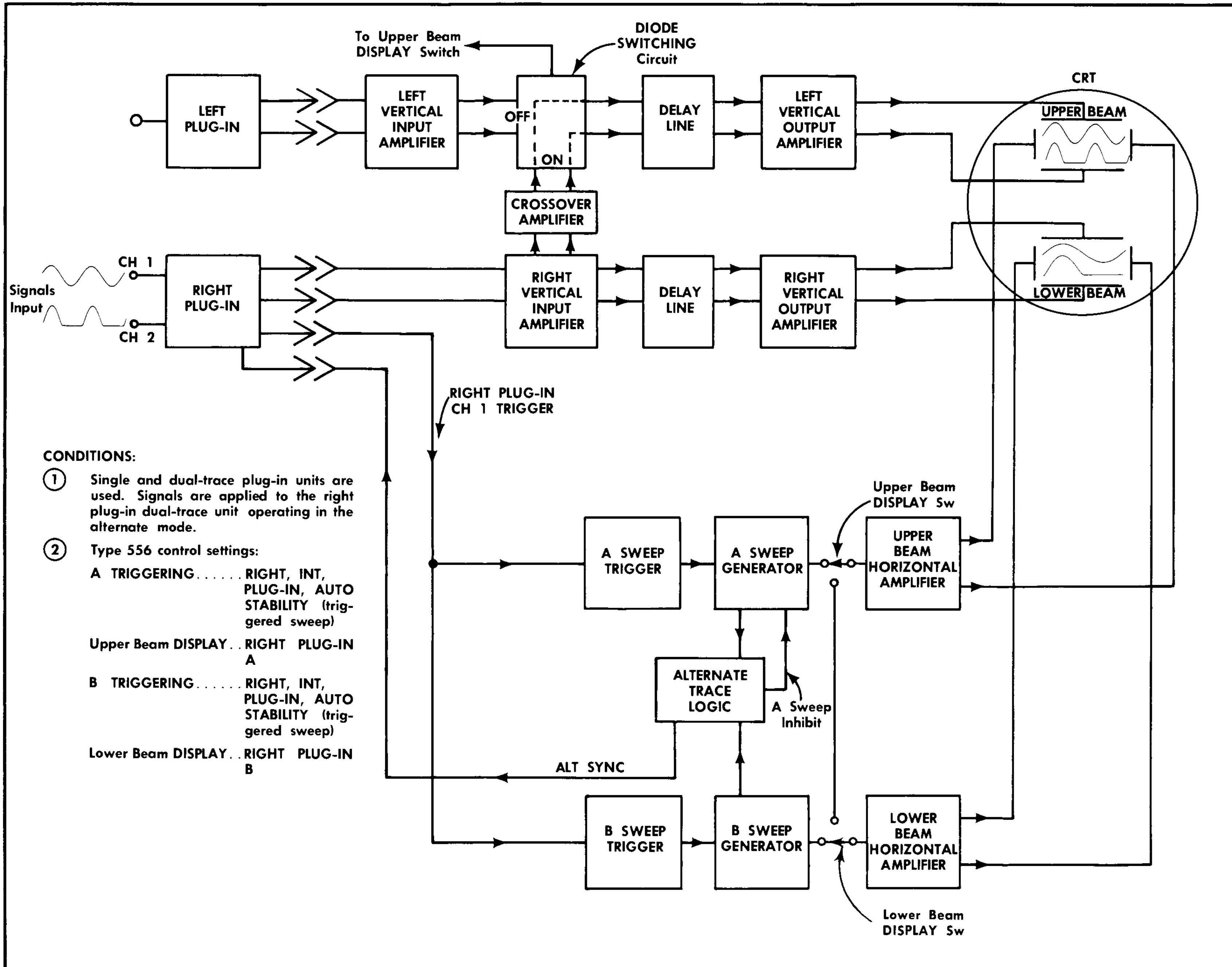

Fig. 3-5. The Type 556 operating as two interconnected vertical deflection systems and two independent horizontal deflection systems. The A Sweep Inhibit gate assures that only one Alt Sync pulse per slower sweep is obtained to alternate the right plug-in.

alternate sync pulse switches the plug-in unit to channel 2. Both sweeps start again and deflect their respective beams so a dual-beam display of channel 2 is obtained.

If the B Sweep is the slower sweep, the A Sweep will run only once and is locked out by the A Sweep Inhibit gate until the B Sweep resets. Since the A Sweep is the only one which is locked out in each case, best results are obtained by running the B Sweep at the same rate or faster than the A Sweep. This same operating characteristic applies if a single-channel plug-in unit is used.

As shown in Fig. 3-5, the A and B Triggering switches are set to RIGHT, INT, PLUG-IN. In these positions the channel 1 trigger is applied from the right plug-in to both Sweep Trigger circuits and the internal triggering signal from the Left and Right Vertical Input Amplifiers are not used. Thus, use of the channel 1 trigger permits the channel 1 input signal to be used as the time reference for channel 2.

If the dual-trace unit is set for chopped-mode operation, (not shown in Fig. 3-5) the plug-in sends chopped blanking pulses via the Chopped Blanking Amplifier and CRT Cathode Selector switches to the CRT cathodes to blank out the traces during the channel-switching intervals.

Sixth Basic Mode (Fig. 3-6)

For the conditions given in Fig. 3-6, the Type 556 is operating as two interconnected vertical deflection systems with the right plug-in signal displayed by both beams. The horizontal deflection systems are operating independently since each beam is driven by its respective Sweep Generator and Horizontal Amplifier. In this (Delayed B Sweep) mode of operation, where the B MODE switch is set to DLY'D BY A and the B Triggering is automatic, the B Sweep starts automatically after the A Sweep delay time.

If the right plug-in triggering signals from the Right Vertical Amplifier are applied to the B Sweep Trigger circuit and the B Triggering controls are set for triggered operation, the B Sweep will not start automatically after the delay time but must be triggered by a right plug-in internal triggering signal. Once triggered, the B Sweep will run. Delay time is determined by the A TIME/CM switch in the A Sweep Generator circuit and the DELAY-TIME MULTIPLIER control in the Delay Pickoff circuit. To prevent the A Sweep from running again until the B Sweep can reset, the B Gate is applied to an Inverter stage in the Alternate Trace Logic circuit. The inverted B Gate is used as an A Sweep Inhibit gate to lock out the A Sweep. When the sweeps reset, the A Sweep will run again when triggered by the right plug-in signal and the cycle is repeated.

Referring to Fig. 3-6 again, this same mode of operation can be changed easily to single-sweep B delayed mode by setting the A MODE switch to SINGLE SWEEP. When triggered, the A Sweep will run only once, the B Sweep will run automatically after the delay time and the sweeps will not start again until the A MODE RESET button is pressed and the A Sweep is triggered to repeat the cycle.

CIRCUIT ANALYSIS

The following circuit analysis of the Type 556 is keyed to detailed block diagrams that are provided in this portion of the manual. These diagrams give the names of the individual stages and show how they are connected together to form a major circuit. The major circuits from which the detailed block diagrams are derived, are shown on the schematic diagrams located on the pullout pages in the Diagrams section.

Each schematic diagram has been assigned a reference diagram number in a diamond frame; for example, Left Vertical Amplifier ◇1 . These numbers are used throughout the detailed block and schematic diagrams as references to point out where a circuit on one diagram ties into the circuit on another diagram. When reading through the description, refer to the schematic diagrams for electrical values of components, voltages, waveforms and other detailed information as needed.

As supplemental information to the detailed blocks provided in this section, there are two more block diagrams provided on pullout pages in the Diagrams section. These diagrams show the interrelationship of blocks throughout the vertical and horizontal systems.

LEFT VERTICAL AMPLIFIER ◇1

Input Cathode Follower, V3

The push-pull output of the left plug-in, with a fixed DC level of about +67.5 V, is applied to the Input Cathode Follower V3 stage (see Fig. 3-7) via pins 1 and 3 of the plug-in connector J11.

Letter-series plug-in units, when inserted into the oscilloscope, actuate the transient-response compensation switch SW105. This switch connects a series network, C100 and R100, across the input to V3A and V3B. The network compensates for the slight difference in transient response that exists between the letter- and 1-series vertical plug-in units. Since the switch is mechanically actuated by the plug-in, no attention on the part of the operator is required.

Resistors R1 and R101, connected in series with the grids of V3A and V3B, are parasitic suppressors. V3A and V3B are two halves of a 12AT7 twin-triode tube. The cathodes of the tube are returned to ground through the DC BALANCE control R5. This control adjusts the bias voltages of V3A and V3B so that the CRT trace will come to graticule center with V3A and V3B grids connected together.

The heaters of V3 and V661 (see Heater Wiring diagram) are part of a series heater circuit which receives power from the +100-V DC supply. V3 and V661 heaters drop the voltage 25 V to provide 75 V at 150 mA to the remaining portion of the heater string located in the left plug-in unit. The DC voltage supply to the plug-in heaters eliminates hum modulation of the cathodes and stablizes the tube gain.

Protection diodes D4 and D104 prevent V3 cathodes from going below +61 V. This voltage is set by a 39 V zener, D6, connected between the anodes of the diodes and the +100 V supply. D4 and D104 are normally back-biased, but if the cathode voltages should attempt to decrease below +61 V, the diodes will conduct and clamp the cathodes, thus preventing any further decrease in cathode voltage. Zener D6 is also connected to a voltage divider network. At the junction of R6 and R7 the voltage is about +50 V which is used as the low-impedance voltage source for the Diode Switch-

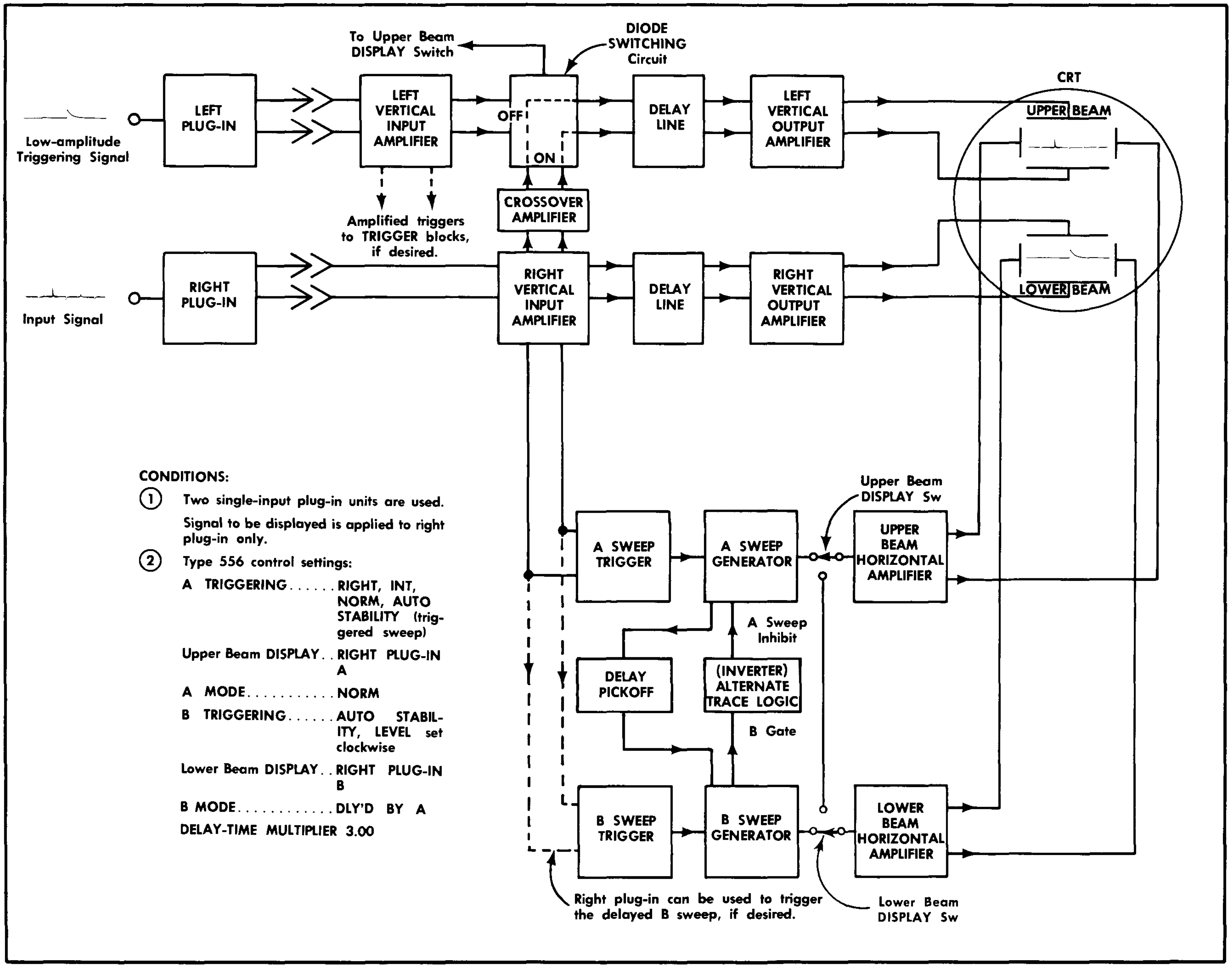

Fig. 3-6. The Type 556 operating as two interconnected vertical deflection systems and two independent horizontal deflection systems. The B Sweep starts automatically after A Sweep delay time. If B Sweep is set for triggered operation (dashed lines to B Sweep Trigger), B Sweep runs when triggered by signal occurring after delay time.

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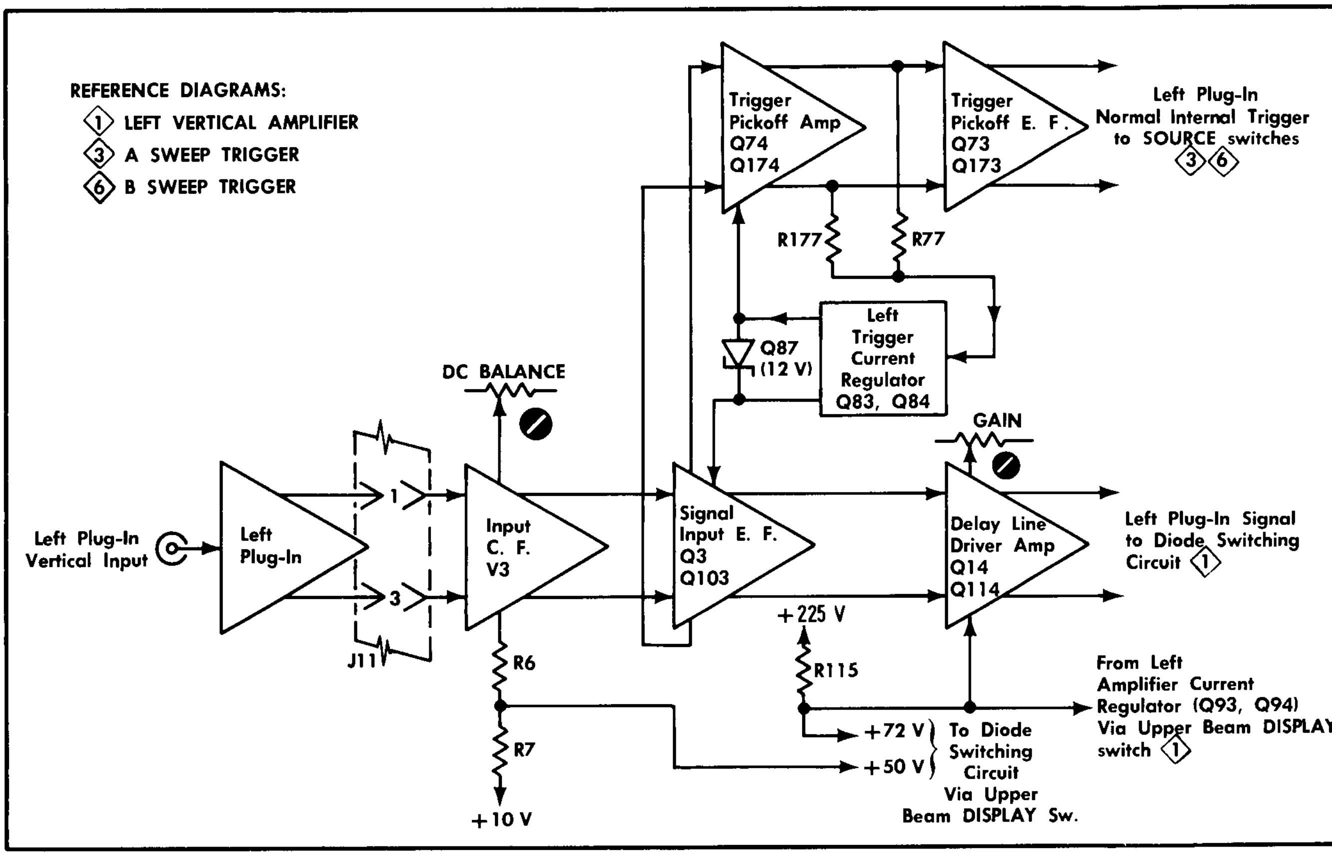


Fig. 3-7. Partial block diagram of Left Vertical Amplifier.

ing stage to be described later. Diodes D8, D108, D9 and D109 (for SN 100-1999, D7, D8, and D108) provide protection for certain transistors in the stages that follow.

Signal Input Emitter Follower, Q3 and Q103

The push-pull left plug-in signal from the Input C. F. stage is applied to the Signal Input E. F. (Q3, Q103) stage. For signal purposes, this stage is an emitter follower since the output is taken from its emitters. However, the collector circuits operate in a cascode configuration with the Trigger Pickoff Amplifiers (Q74, Q174).

To compensate for variations between plug-in units in output DC level from the nominal +67.5 V, the output from the Trigger DC Collector Current Regulator stage (Q83, Q84) is applied to R9 and R109 in the emitter circuit of Q3 and Q103. Further details about the regulator stage are described later.

Trigger Pickoff Amplifier, Q74 and Q174

To obtain a push-pull triggering signal which is always available for normal internal triggering purposes when the SOURCE switch is set to LEFT, INT, NORM, the signal must be taken off ahead of the Diode Switching stage. This is accomplished by connecting the Trigger Pickoff Amplifier (Q74, Q174), in a cascode configuration with the Input E. F. stage.

The push-pull internal trigger output from Q74 and Q174 is applied to the Trigger Pickoff E.F. stage.

Trigger Pickoff Emitter Follower, Q73 and Q173

This stage provides low-impedance drive for the A and B Triggering SOURCE switches. When the SOURCE switches are set to LEFT, INT, NORM, the normal internal triggering signal with its regulated DC output level is coupled to the A and B Sweep Trigger circuits for use in triggering the A and B Sweep Generator circuits.

Left Trigger Current Regulator, Q83 and Q84

The regulator stage consisting of Q83 and Q84 with associated circuitry acts as a series bootstrap element that automatically regulates the common-mode DC collector currents so that collector voltage levels are held constant. This is particularly important when using the DC coupling mode of triggering. When using this mode, the DC levels at the collectors of Q74 and Q174 must be held at a nominal value to maintain proper DC levels at the emitters of Q73 and Q173 for application to the Sweep Trigger circuits.

If the plug-in output DC level is more or less than +67.5 V, this common-mode voltage change from the nominal value of of 67.5 V tends to cause a current change through Q3, Q103, Q74 and Q174. This current change tends to change the voltage at the collectors of Q74 and Q174. As a result, an error signal is developed at the junction of L77 and L177.

The error signal is applied to the base of Q83. This transistor operates as an emitter follower for the error signal which is then applied to the base of Q84. Transistor Q84 and associated circuitry acts as a series-element regulator in the emitter circuit of Q3 and Q103 comparing the error signal voltage to the +100 V supply. By resetting the emitter voltages of Q3 and Q103, current through the transistors is the same as if the plug-in output level were +67.5 V.

The regulating action of Q83 and Q84 causes the voltage at the junction of L77 and L177 to remain constant so the collector voltage of Q74 and Q174 are maintained at a nominal level for application to the bases of Q73 and Q173. Thus, with the plug-in unit Position control centered so the voltages at pins 1 and 3 of J11 are equal, the voltage at the emitters of Q73 and Q173 should be about +50 V.

The zener diode drop across D87 is used as a reference voltage for the bases of Q74 and Q174. Thus, the bases move up and down in phase with the junction of R9 and R109, but 12 volts removed by D87.

Delay Line Driver Amplifier, Q14 and Q114

The balanced Delay Line Amplifier stage, Q14 and Q114, is a push-pull stage which is actually connected in cascode with Q44 and Q144. An adjustable vertical GAIN control R12 is provided in the emitter circuit. Gain is adjusted by controlling the amount of degeneration. Variable capacitor C10 is adjusted to vary the time constant sufficiently to optimize the transient response.

The RC networks in the collectors of Q14 and Q114 are thermal time constant compensations. The push-pull signal from this stage provides signal current drive for the Diode Switching circuit and delay line.

In the LEFT PLUG-IN positions of the Upper Beam DISPLAY switch, the Left Amplifier Current Regulator, Q93 and Q94, provides a regulated current via R14 and R114 to the emitters of Q14 and Q114.

Diode Switching Circuit

Fig. 3-8 shows the operation of the Diode Switching circuit. This circuit permits passage of either the left or right plug-in signals to the Upper Beam vertical deflection plates. The Upper Beam DISPLAY switch is used to control the switching of the diodes.

The LEFT and RIGHT positions of the Upper Beam DISPLAY switch shown in Fig. 3-8 correspond to these front-panel positions: LEFT is any of the LEFT PLUG-IN positions and RIGHT corresponds to the RIGHT PLUG-IN positions. Assume the Upper Beam DISPLAY switch is set to the LEFT position. +72 V is applied from the collector circuit of Q94 (see Fig. 3-7) to the cathode junctions of D17 and D117 to turn these diodes off and turn on diodes D15 and D115. As a result the left plug-in signal passes through diodes D15 and D115 to the left-vertical delay line.

On the other hand, +50 V is applied to the cathode junctions of D19 and D119 to turn these diodes on and turn off diodes D16 and D116. Thus, diodes D16 and D116 prevent the right plug-in signal from being applied to the left-vertical delay line.

If the Upper Beam DISPLAY switch is set to the RIGHT position, just the opposite occurs. +50 V is applied to D17 and D117 and +72 V is applied from the collector circuit of Q94 to D19 and D119. Hence, all the previously on diodes are turned off and the off diodes are turned on. The left pulg-in signal is blocked by D15 and D115; D16 and D116 pass the right plug-in signal to the left-vertical delay line.

Right Plug-In Crossover E. F., Q23 and Q123

The right plug-in signal from the Signal Input E. F. (Q203, Q403) in the Right Vertical Amplifier circuit is applied at all times through 93-ohm coaxial cables to the Right Plug-In Crossover E. F. (Q23, Q123). Termination for the cable is provided by R20 and R120. Purpose of the emitter follower stage is to isolate the impedance of the cables from the input impedance of the Delay Line Driver Amplifier circuit. The input impedance of the right Plug-In Crossover, E. F. stage depends upon settings of the gain and peaking adjustments.

Right Plug-In Crossover Amplifier, Q34 and Q134

This stage is very similar to the Delay Line Driver Amplifier Q14 and Q114 described earlier. In the emitter circuit a CROSSOVER GAIN control R34 is provided to adjust the gain of the stage so the vertical deflection factor of the right plug-in signal amplitude to the Upper Beam vertical deflection plates is the same as that from the left plug-in unit.

Variable capacitors C19, C30 and C31 with R31 are adjusted for optimum transient response. These adjustments vary the high-frequency peaking in the emitter circuit.

In the RIGHT PLUG-IN positions of the Upper Beam DISPLAY switch, a regulator current is fed from the Left Amplifier Current Regulator (Q93, Q94) through the switch via R36 and R136 to the emitters of Q34 and Q134. In the LEFT PLUG-IN positions of the Upper Beam DISPLAY switch, R37 provides "keep alive" current for diodes D19 and D119.

Left Vertical Delay Line

Output from the left or right Delay Line Driver stages is applied through the Left Vertical Delay Line to the Output Driver Amplifier (Q44, Q144). The Delay Line delays the signal about 170 ns to give the Sweep Generator circuit time to initiate a sweep before the vertical signal reaches the Upper Beam vertical deflection plates.

R41-C41 and R141-C141 provide the output termination for the Delay Line; R18 provides the reverse termination. The center-tapped inductors, L18 and L118, at the input to the Delay Line and the collector-base capacitance of the delay line transistors form a T-section matching network. Impedance of the network can be varied by adjusting C17 in the LEFT PLUG-IN positions of the Upper Beam DISPLAY switch and C19 in the RIGHT PLUG-IN positions.

Output Driver Amplifier, Q44 and Q144

This stage forms the other portion of the cascode amplifier with the Delay Line Driver Amplifier Q14 and Q114. Net-

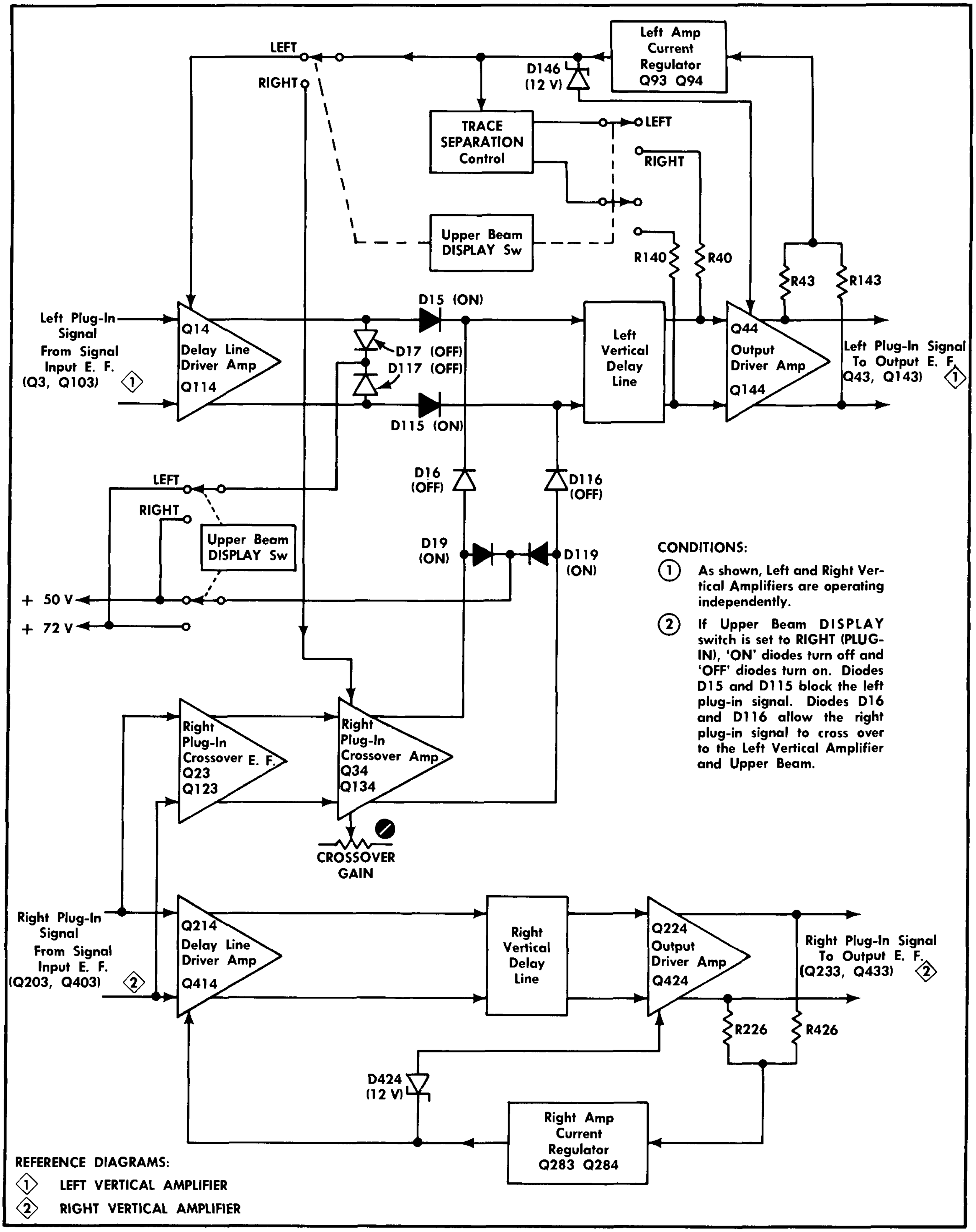


Fig. 3-8. Partial block-and-circuit diagram of Left and Right Vertical Amplifiers. The diodes are located in the Diode Switching circuit of the Left Vertical Amplifier.

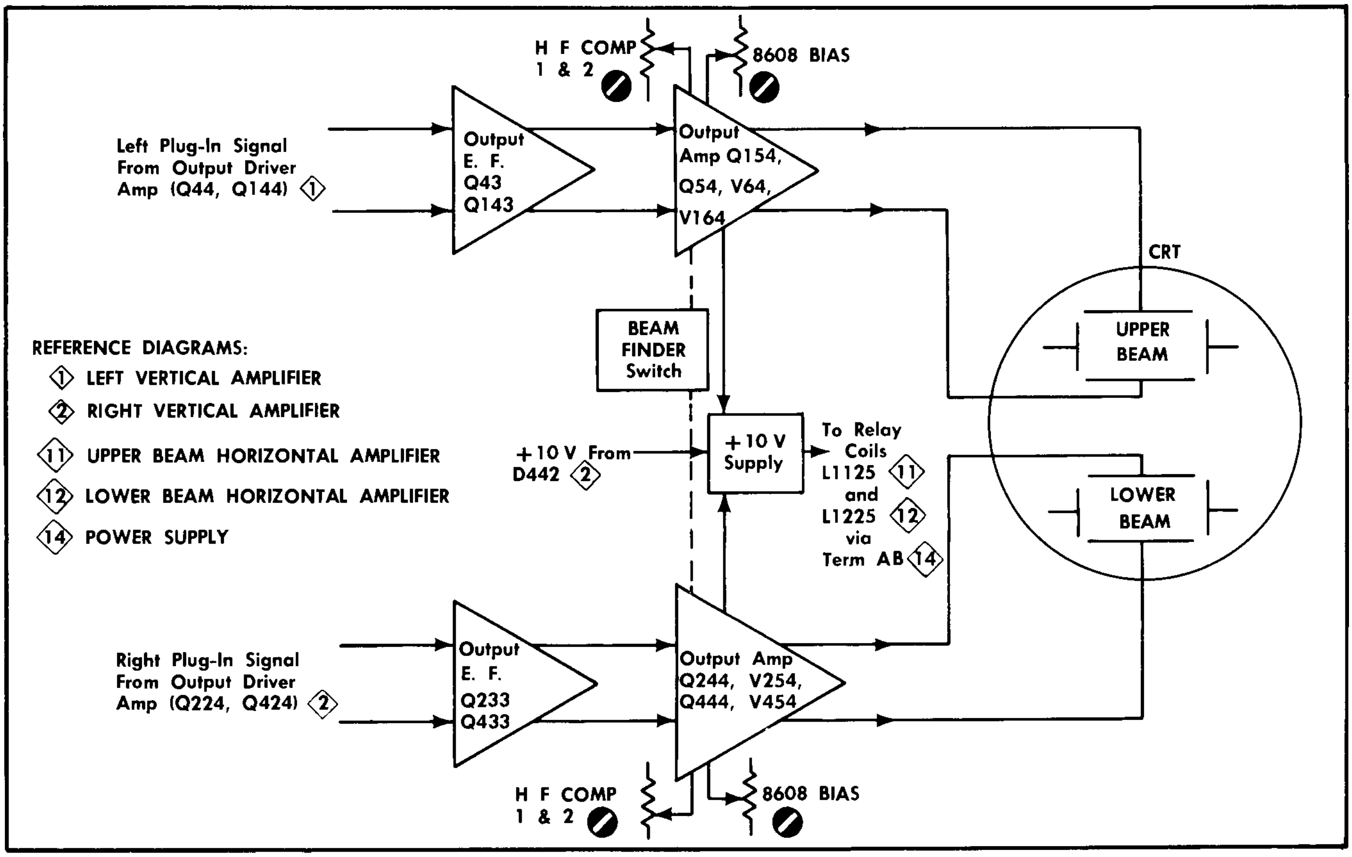


Fig. 3-9. Partial block diagram of Left and Right Vertical Output Amplifiers.

works C42-R42 and R142-C142 are temperature compensations for Q44 and Q144. L43 and L143 are adjustable T-coils for high-frequency peaking.

Zener D144 limits the base-collector voltage to about 22 V for protection purposes. Any change in DC level at the anode of D144 due to a change from nominal in output DC level of the plug-in is applied to the Left Amplifier Current Regulator, Q93 and Q94. D146 supplies base voltage to Q44 and Q144.

A TRACE SEPARATION control R182 is switched into the emitters of Q44 and Q144 when the Upper Beam DISPLAY switch is set to the RIGHT PLUG-IN positions allowing the Upper Beam to be positioned independently of the Lower Beam.

Left Amplifier Current Regulator, Q93 and Q94

This stage regulates the DC collector levels of Q44 and Q144 to compensate for any change in plug-in unit DC output level from the nominal value of +67.5 V.

For regulating purposes, if the DC level at the junction of R90 and R91 tends to change due to a change in current through Q44 and Q144, an error signal is developed and applied to the base of Q93. The emitter output from Q93 is applied to the base of Q94. Transistor Q94 serves as a DC current series regulator to control the emitter current of Q14 and Q114 when the Upper Beam DISPLAY switch is set to any of the LEFT PLUG-IN positions.

In the RIGHT PLUG-IN positions of the switch, the regulating current is applied to the Right Plug-In Crossover Amplifier (Q34 and Q134).

With the Upper Beam DISPLAY switch set to RIGHT PLUG-IN A, the right plug-in vertical Position control positions both beams simultaneously but cannot position one beam with respect to the other. However, the latter situation is solved by adding a TRACE SEPARATION control, R182, in the Q94 collector circuitry. The control varies the DC current through R180 more than through R184, or vice versa, so that the control acts as a vertical positioning control for the Upper Beam.

The positioning currents are applied via the Upper Beam DISPLAY switch through R40 and R140 to the emitter input circuit of Q44 and Q144. When the Upper Beam DISPLAY switch is set to any of the LEFT PLUG-IN positions these positioning currents are disconnected from R40 and R140 so the TRACE SEPARATION control has no effect on the Upper Beam. The control is disconnected at this time because the left plug-in Position control provides the normal vertical positioning range for the Upper Beam.

Output E. F., Q43 and Q143

This stage is an emitter follower for either the left or right plug-in signals from the Output Driver Amplifier (Q44, Q144), depending on the position of the Upper Beam DISPLAY switch.

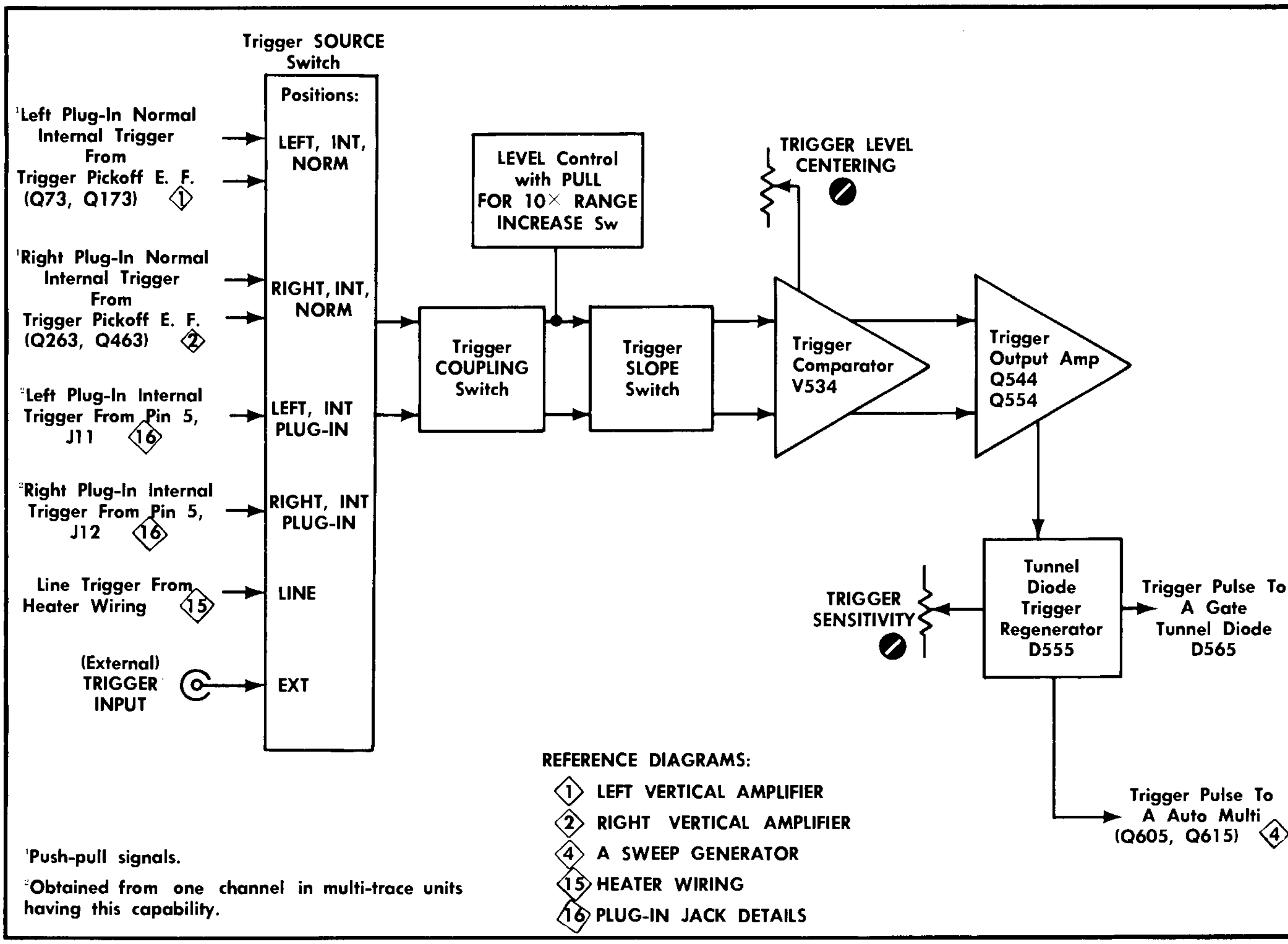


Fig. 3-10. Block diagram of the A Sweep Trigger.

To trace the signal, assume the Upper Beam DISPLAY switch is set to the LEFT PLUG-IN positions. The push-pull left plug-in signal is applied to the bases of Q43 and Q143 and the output signal at the emitters is used to drive the lower part (Q54, Q154) of the hybrid Output Amplifier stage.

Output Amplifier Q54, Q154, V64 and V164

The Output Amplifier stage operates in a hybrid cascode configuration to drive the Upper Beam vertical deflection plates and to raise the DC output level from about +50 V at the bases of the transistors to about +176 V at the deflection plates.

L64 and L164 are T-coils that provide high-frequency peaking in the stage. Other high-frequency compensation adjustments are HF COMP 1 (R52), HF COMP 2 (R54), C51, C53, C54 and C55.

The BEAM FINDER button, when pressed, disconnects R150 and R151 limiting the emitter current to Q54 and Q154. This restricts the dynamic operating range of the transistors limiting the trace to the Upper Beam display area. The BEAM FINDER switch SW155 also connects R62 and R162 in shunt with Q54 and Q154 maintaining current through V64 and V164 essentially constant, so that the average CRT deflection plate potential does not change. The BEAM FINDER switch SW155 performs a similar function in the Right Vertical Amplifier circuit. This same switch is used in the Upper and Lower Beam Horizontal Amplifier circuits to restrict the horizontal deflection simultaneously with the vertical deflection.

The +10 V in the emitter circuit of Q54 and Q154 is a supply voltage obtained from zener D442 in the Q244-Q444 emitter circuit of the Right Vertical Amplifier. This voltage goes to terminals AB in the Power Supply circuit for distribution to relay coils L1125 (Upper Beam Horizontal Amplifier) and L1225 (Lower Beam Horizontal Amplifier).

In the grid circuit of V64 and V164 there is an 8608 BIAS adjustment R69. This adjustment sets the collector voltage across Q54 and Q154 for correct thermal characteristics.

RIGHT VERTICAL AMPLIFIER 2

This circuit is the same as the Left Vertical Amplifier except for the crossover amplifier and TRACE SEPARATION control circuitry which have already been described.

A SWEEP TRIGGER 3

Trigger Source

The triggering signal source is selected with the SOURCE switch SW515. Six sources are available and they are all shown being applied to the SOURCE switch block in Fig. 3-10. The SOURCE switch block lists all the SOURCE switch positions. Each position is shown with its corresponding signal source.

Trigger Coupling

The COUPLING switch offers a means of accepting or rejecting certain frequency components of the triggering signal. In the AC and AC LF REJ positions, the DC component of a push-pull signal is blocked by coupling capacitors C501 and C502, and C525 or C526. In the AC position, frequency components below about 30 Hz will be attenuated. In the AC LF REJ position, frequency components below about 1.6 kHz will be attenuated.

The AC HF REJ position attenuates high-frequency components of the triggering signal. The signals are AC-coupled and are attenuated below about 60 Hz and above about 100 kHz. In the DC position, the push-pull normal internal triggering signal is DC-coupled to the triggering circuit via dividers R504-R505 and R520-R521. The no-signal DC level at the input to the dividers with the plug-in Position control centered is about +50 V. At the output of the dividers the voltage is about zero.

Trigger Level

The A Triggering LEVEL control R518 applies a DC voltage to one grid or the other of V534, depending on the position of the SLOPE switch. Purpose of the LEVEL control is to set the DC push-pull current through Q544 and Q554 to a point where the trigger signal current will cause tunnel diode D555 to switch states. Switching of the tunnel diode to its high state always occurs on the positive-going rising portion of the waveform at Q554 collector.

With the SLOPE switch set to + and the LEVEL control pushed inward as shown on the A Sweep Trigger schematic diagram, voltage range of the control at the grid of V534B is about ±2 V when measured using a DC-coupled oscilloscope having a 10-megohm input loading. When the control is pulled outward to the ×10 RANGE INCREASE position, R511 is bypassed and the voltage range is about ±20 V. If the LEVEL control knob is properly positioned on the shaft, the knob should point to 0 when voltage at the grid of V534B is zero.

Trigger Slope

The + and — positions of the SLOPE switch SW520 provide a means of inverting or not inverting the single-ended signal which is applied to the anode of D555. This is accomplished by switching the triggering signal at the grids of V534.

In the + position of the SLOPE switch, a positive-going incoming single-ended triggering signal applied to the junction of R526 and R528 will be applied to the grid of V534A. The signal will have the same polarity when applied to D555. If the SLOPE switch is set to —, the signal will be applied to the grid of V534B and will be inverted when applied to D555 so D555 can switch on the falling (positive-going) portion of the displayed waveform. This is done so the positive-going trigger at the output of the A Sweep Trigger can be made to occur during either a positive-going or a negative-going portion of the triggering signal.

Trigger Comparator V534

The Trigger Comparator circuit consists of a cathode-coupled vacuum tube pair, V534A and V534B. In operation, the circuit is a push-pull amplifier which drives a Trigger Output Amplifier Q544 and Q554.

The A TRIGGER LEVEL CENTERING control R545 in the plate circuit of V534 is adjusted so the base voltages on Q544 and Q554 are equal when V534 grid voltages are zero. Coil L547 is energized when the COUPLING switch SW510 is set to the AC HF REJ position. The coil closes SW547 contacts to connect C547 across V534 output and limit the high-frequency push-pull response of the circuit.

Trigger Output Amplifier, Q544 and Q554

Push-pull signals from V534 are applied to the Trigger Output Amplifier stage, Q544 and Q554. The push-pull input signals are converted to single-ended output signals at the collector of Q554 for application to tunnel diode D555.

Tunnel Diode Trigger Regenerator D555

For discussion purposes, assume these conditions: The SLOPE switch is set to +, the LEVEL control is set in the + region, and the current through D555 is such that the tunnel diode is in its low state (see Fig. 3-11 for the characteristic

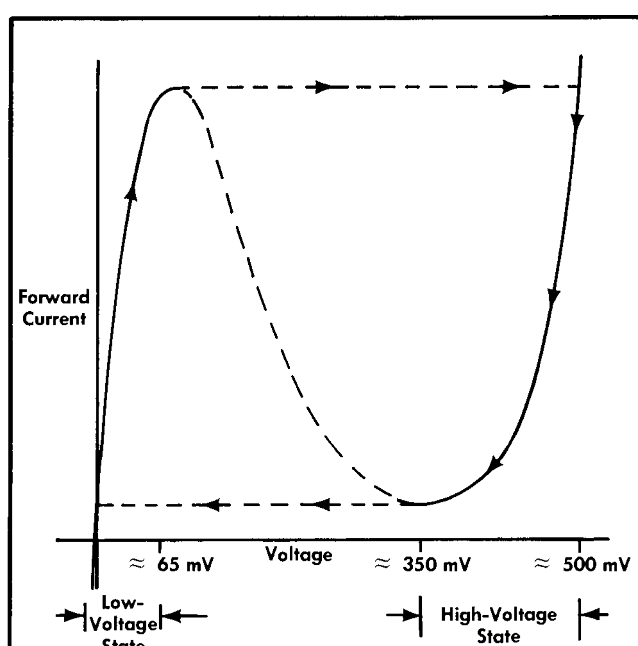


Fig. 3-11. Tunnel diode characteristics.

curve of a tunnel diode). When a positive-going trigger is applied to the grid of V534A, the trigger is negative-going at the base of Q554. Collector current of Q554 increases and this increased current flows through D555, causing D555 to switch to its high state. The sudden switching of D555 to its high state causes the tunnel diode to produce a positive-going trigger having a uniform amplitude and a fast rise for application to the Sweep Gate Tunnel Diode D565 and to the A Auto Multivibrator stage, Q605 and Q615.

When the positive-going trigger at the base of Q554 returns to the original starting level, decreased current through Q554 resets the tunnel diode to its low state. R553 and the A TRIGGER SENSITIVITY control R556 sets the load and bias on D555 so the tunnel diode has a small hysteresis but not small enough to switch states on internal noise or to self-oscillate.

B SWEEP TRIGGER ⑥

The B Sweep Trigger is similar to the A Sweep Trigger in every respect except the B Sweep Trigger drives the B Sweep Generator.

A SWEEP GENERATOR ④ and A SWEEP TIMING SWITCH ⑤

General

The A Sweep Generator produces seven simultaneous output signals controlled by four input signals (see Fig. 3-12). There are two more input signals but these control only a portion of the A Sweep Generator circuit when certain Upper Beam DISPLAY switch positions are used. The input signals are:

1. For triggered-sweep operation, a positive-going trigger from D555 in the A Sweep Trigger.

2. For auto-stability operation, a DC threshold level determined by the A Auto Multivibrator circuit, Q605 and Q615.

3. For single sweep operation, a positive-going reset pulse generated by operating the RESET button.

4. For RIGHT PLUG-IN A operation, a positive-going inhibit gate from the Alternate Trace Logic and Blanking Circuit.

5. In RIGHT PLUG-IN A, DLY'D BY A operation, a positive-going trace brightening pulse (restored to normal intensity during B sweep) from R799 in the B Sweep Generator circuit. This pulse controls the Upper Beam unblanking circuitry only. In addition, there is a positive-going inhibit gate coming from the Alternate Trace Logic and Blanking circuit.

6. In RIGHT PLUG-IN operation, a negative-going B gate during B sweep from Q763 and Q773 in the B Sweep Generator circuit. This gate pulse controls the Upper Beam unblanking circuitry only.

The output signals are:

1. Positive-going unblanking pulse applied to the CRT Circuit Upper Beam control grid.

2. Positive-going gate signal to the A GATE connector on the front panel.

3. Negative-going gate signal during the A Sweep to D1024 in the Alternate Trace Logic and Blanking circuit.

4. Positive-going A sawtooth signal to the Upper Beam Horizontal Amplifier via the Upper Beam DISPLAY switch.

5. Positive-going A sawtooth signal to the Delay Pickoff circuit.

6. Positive-going A sawtooth signal to pin 6 of J11. Used for driving a left plug-in spectrum analyzer capable of utilizing this signal.

7. Positive-going A sawtooth signal to the front-panel A SAWTOOTH connector.

8. Positive-going A sawtooth signal to the Lower Beam Horizontal Amplifier, via the Lower Beam DISPLAY switch.

To simplify the operational description of each stage shown in Fig. 3-12, the description initially assumes that the conditions are as follows:

1. The front-panel controls are set as follows:

A Triggering	LEFT, INT, NORM, TRIG; LEVEL control is set for triggered operation.
Upper Beam DISPLAY	LEFT PLUG-IN A
A MODE	NORM

2. The A Sweep Generator circuit is in its quiescent state ready to be triggered by a triggering pulse from D555.

3. The description for each stage begins with the stage in its quiescent state; i. e., the A Sweep Generator circuit is ready to be triggered. Then, the discussion proceeds to describe the operation as D555 triggers the sweep. Refer to Figs. 3-12, 3-13, 3-14 and the appropriate schematic diagrams when following the description. Other modes of operation, but only those of most importance where the input signal directly affects the stage, are briefly described last. All signal amplitudes and voltages stated in the text are approximate.

A Gate Tunnel Diode D565

During quiescence, tunnel diode D565 is in its low state. Bias current is set by R561, D562 and R563 connected to the +100 V supply.

To switch D565 to its high state, a positive-going trigger from D555 is required. The trigger is coupled through C560 to L560 and D561. C560 and L560 form a differentiating network to provide a very narrow trigger pulse to D565. Diode D560 clamps the junction of L560 and R560 at about +0.5 V.

Upon application of the trigger pulse, D565 switches to its high state and the A Sweep Generator circuit produces a sawtooth. At a point determined by the A SAWTOOTH AMPL control R678, the Holdoff Multi changes state, V625A returns D565 to its low state and holds D565 in the low state until holdoff capacitor C675 discharges to a point where V625A will allow D565 to accept another trigger. The output signal from D565 is a 350-mV positive-going gate applied to the base of Q564. Duration of the gate is equal to the ramp time of the sawtooth.

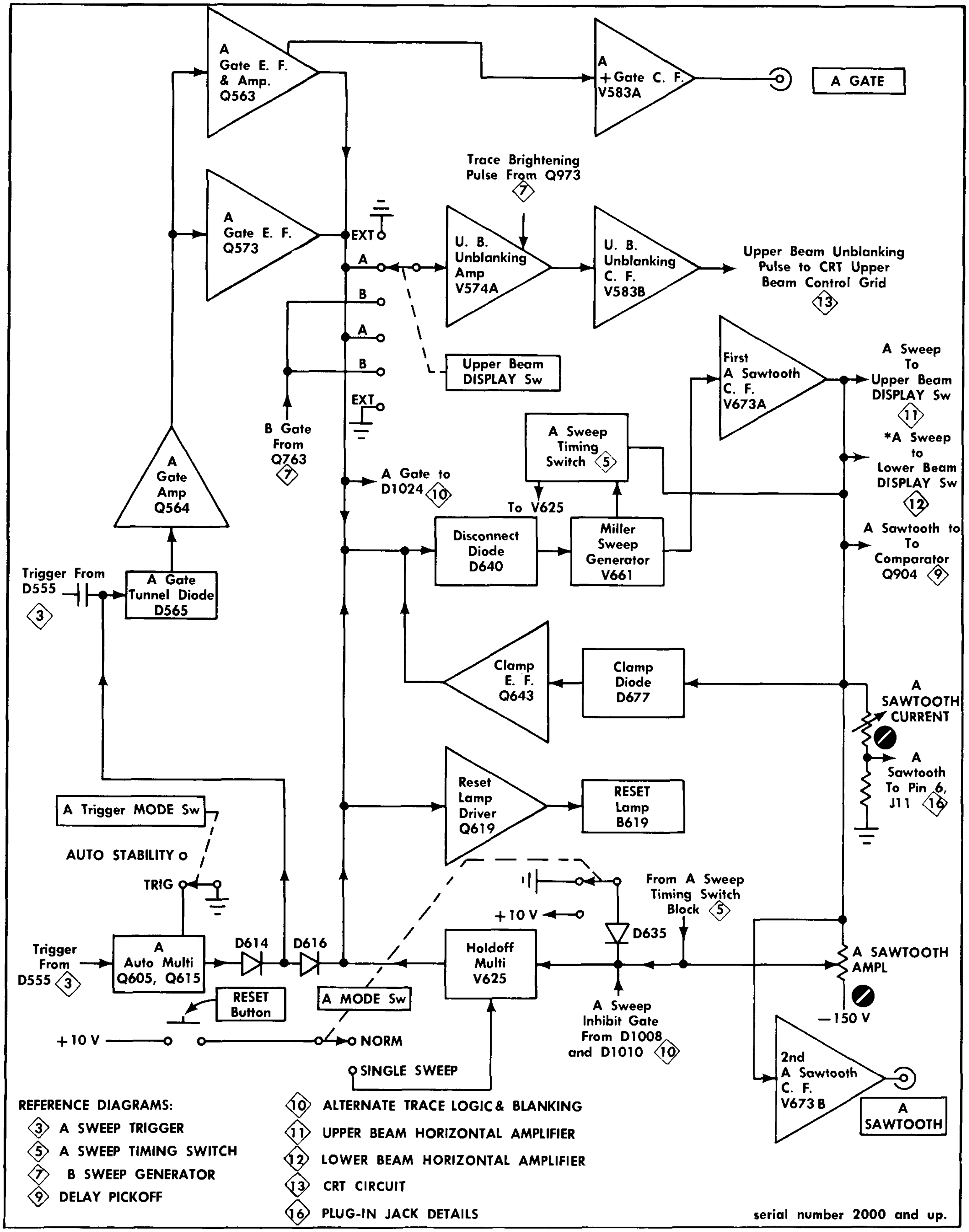


Fig. 3-12. Block diagram of the A Sweep Generator circuit.

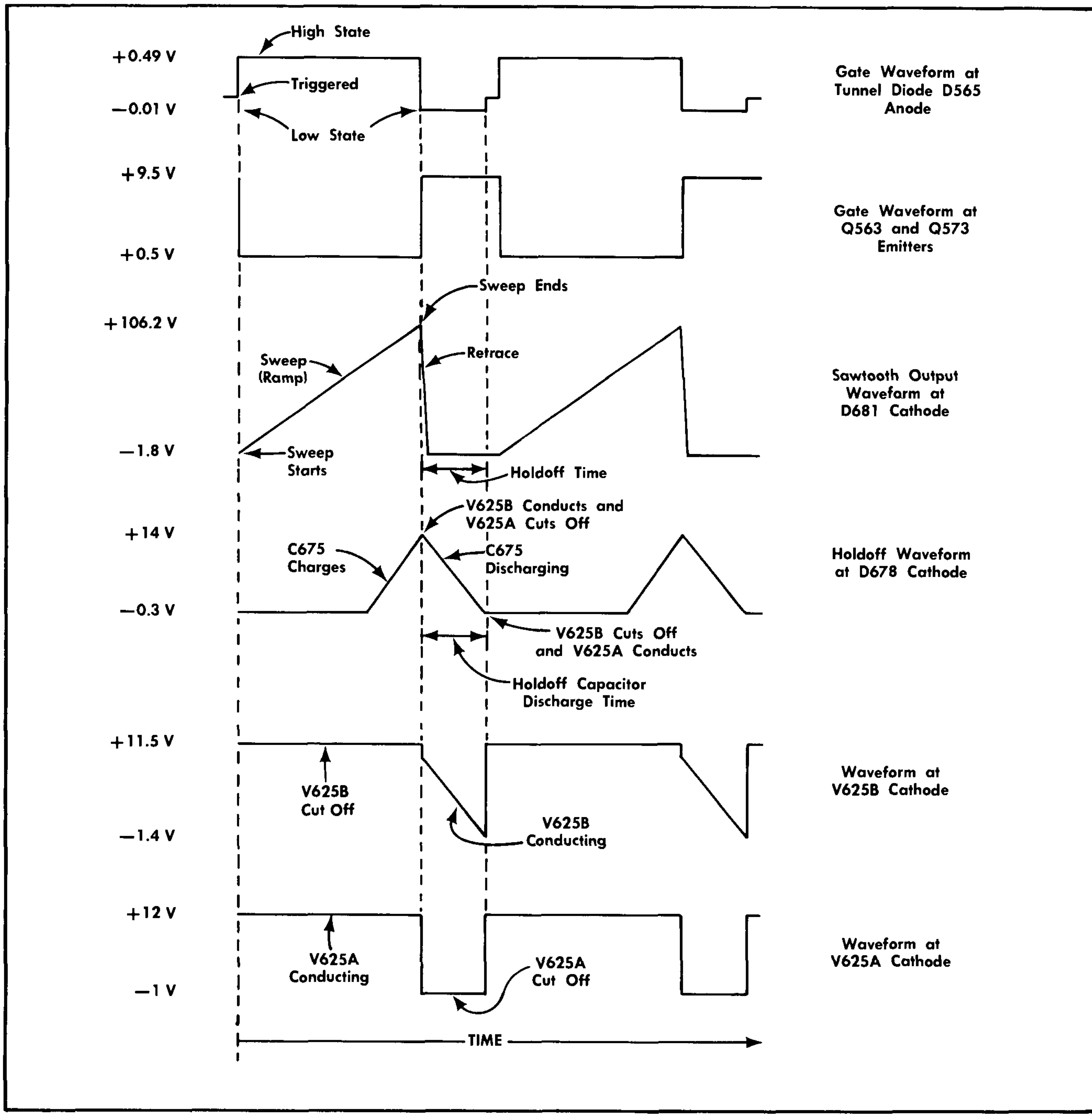


Fig. 3-13. Illustration showing time relationship of waveforms in the A Sweep Generator circuit starting at the quiescent voltage levels.

When the A Triggering MODE switch is set to AUTO STABILITY, and triggers from D555 are absent, the A Auto Multivibrator stage (Q605, Q615) sets the DC threshold level of D565 so the sweep cycle can be repeated to obtain a free-running sweep.

A Gate Amplifier Q564

In its quiescent state, Q564 is cut off. When a trigger is applied to D565 and the tunnel diode switches to its high state, D565 drives Q564 into saturation. Q564 remains saturated until D565 returns to the low state. The voltage waveform at Q564 collector is a 10.5 V negative-going gate applied to the bases of Q563 and Q573. Duration of the gate is equal to the ramp time of the sawtooth.

A Gate Emitter Follower and Amplifier Q563

The 10.5 V negative-going gate from Q564 collector is applied to the bases of Q563 and Q573. The following discussion describes the A Gate Emitter Follower Q563 stage. In its quiescent state, Q563 is cut off. When the gate is

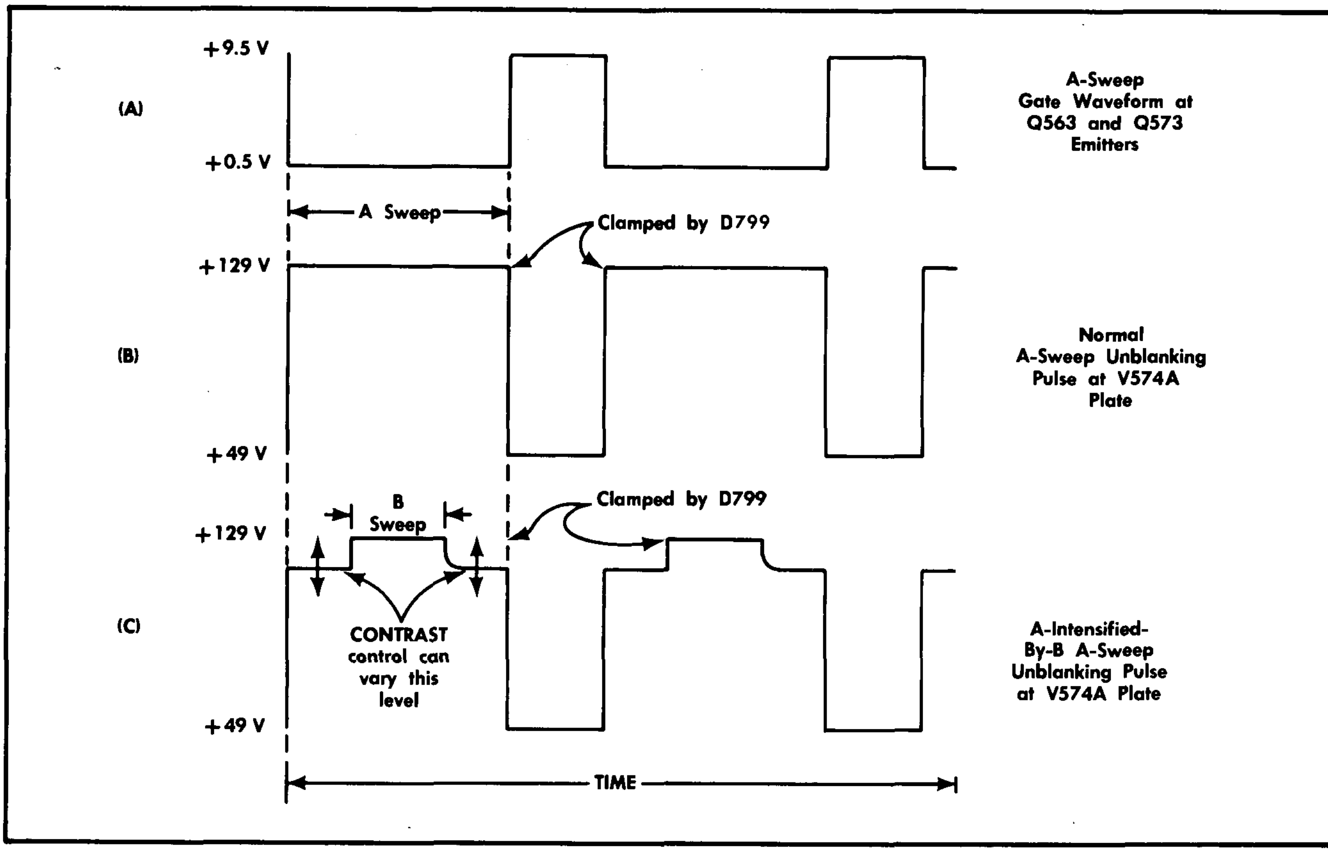


Fig. 3-14. Time-related waveforms showing how the CONTRAST control varies the non-intensified DC level of the A Sweep unblanking pulse.

applied, Q563 is driven into saturation until the gate ends. The emitter waveform from this stage has the same polarity as the input and the amplitude is about 9 volts. Purpose of the stage is to provide a fast-rise negative-going low-impedance drive to the following circuits (see Fig. 3-12).

1. When the Upper Beam DISPLAY switch is set to LEFT PLUG-IN A or RIGHT PLUG-IN A, the 9-V negative-going gate is applied to the Upper Beam Unblanking Amplifier V574A. The gate is then amplified and inverted for use in unblanking the Upper Beam.

2. The 9-V negative-going gate is applied to D1024 in the Alternate Trace Logic and Blanking circuit to provide drive to the logic circuit and then (during gate turn off) to produce an alternate-trace sync pulse that can be used by the left plug-in multi-trace unit.

3. The 9-V negative-going gate is applied to Disconnect Diode D640 to turn off the diode so a sweep sawtooth can be generated.

4. The waveform at the collector of Q563 is a positive-going 14-V +gate source for driving the grid circuit of V583A so this waveform is available at the A GATE connector every time the sweep runs. Diode D570 clamps the collector of Q563 so the gate cannot go higher than the diode bias above ground for the duration of the gate.

A Gate Emitter Follower Q573

Transistor Q573 with associated components is connected in a complementary circuit with Q563. The purpose of Q573 is to provide a fast-rise positive-going gate at the end of the sweep through its emitter follower action.

In its quiescent state, Q573 is conducting. When the gate is applied to its base, Q573 is driven into cutoff and remains in this state until the gate terminates. When the gate ends, Q573 is quickly turned on and this completes the cycle. The fast turn-on of Q573 is necessary for driving V1043A to obtain the proper alternate-trace sync pulse amplitude.

Disconnect Diode D640

Disconnect Diode, D640, is forward-biased and quiescently conducting current through Q573, R640 and R660. When tunnel diode D565 is triggered and switches to its high state, the 9-V negative-going gate from transistors Q563 and Q573 is applied to D640. The gate reverse biases D640 and the current through D640 is interrupted, and the Miller circuit generates a sawtooth. When the sweep terminates and the negative-going gate at Q563 emitter returns to its quiescent level, D640 is forward biased again, thus completing the cycle. Diode D641 is a protection diode for D640 and is normally not conducting.

Miller Sweep Generator V661 and A Sweep Timing Switch ⟨5⟩

In its quiescent state V661 is conducting heavily. When the negative-going gate reverse biases Disconnect Diode D640, timing capacitor C660 begins to charge through the timing resistor R660 and the VARIABLE control R662 (see A

Sweep Timing Switch diagram; more details about this diagram are given later).

As C660 begins to charge, a negative-going change in voltage occurs at the grid of V661, is amplified by a factor of about 200 and appears as a positive-going voltage at the plate of the tube. This amplified change is coupled back through V673A, D675 and D681 to the output side of timing capacitor C660. The coupled-back change tends to oppose any change at the grid side of the timing capacitor. This feedback action continues throughout the sawtooth rise, limiting the total negative excursion at the grid of V661 to less than 1 V.

With the grid of V661 held at nearly constant voltage level, the voltage across the timing resistor R660 remains essentially unchanged. Current through the resistor is therefore constant and the timing capacitor charges linearly. The resulting voltage change at the cathode of V673A, and hence, the output end of C660, is a linear positive-going sawtooth (about 105 V in amplitude at 1 ms/cm) that is capable of driving the following circuits:

1. Via LEFT PLUG-IN A and RIGHT PLUG-IN A positions of the Upper Beam DISPLAY switch to the base of Q1135 in the Upper Beam Horizontal Amplifier.

2. Via RIGHT PLUG-IN A position of the Lower Beam DISPLAY switch to the base of Q1235 in the Lower Beam Horizontal Amplifier.

3. To the grid of V904A in the Delay Pickoff circuit.

4. To pin 6 of the left plug-in jack J11 in the Plug-In Jack Details circuit, for use by Spectrum Analyzer plug-in units that are wired to accept this signal.

5. A sample sawtooth the grid of V625 in the Holdoff Multivibrator circuit (A Sweep Generator circuit).

6. A sawtooth to grid of V673B in the Second A Sawtooth C. F. (A Sweep Generator circuit).

The sweep rate (the rate at which the spot moves across the face of the CRT) is determined by the rate at which the timing capacitor and timing resistor permit the Miller Sweep Generator to run up. By means of the A TIME/CM switch SW660 (see A Sweep Timing Switch diagram), both the size of the capacitor being charged and the charging current can be selected to cover a wide range of sawtooth slopes (sweep rates). Note that SW660 is connected so that switching 8 capacitors and 6 resistors provides 24 different sweep rates, from 5 s/cm to 0.1 μs/cm without magnification. The A TIME/CM switch also selects the proper holdoff capacitor and discharge resistor for the sweep rate in use.

Adjustable capacitors C660G, C660H, and C660J are adjusted to obtain correct sweep timing at the fastest sweep rates.

Continuously variable uncalibrated sweep rates are provided by R662 and SW662 (mounted on and actuated by R662). When SW662 is switched to the uncalibrated position, the switch removes the short from around R662 and turns on the UNCAL neon B663. By turning VARIABLE control R662, the charging time of the timing capacitor selected by the A TIME/CM switch may be increased by at least 2.5 times the calibrated rate, thus providing continuously variable sweep rates.

First A Sawtooth Cathode Follower V673A

The First A Sawtooth Cathode Follower V673A stage isolates the output shunt capacitances and load from the circuitry associated with the Miller tube V661. The 105 volt positive-going sawtooth waveform at the grid of V673A produces the same waveform at the cathode for distribution to all points as described earlier.

Neon B670 is a protection device that prevents V673A grid from becoming too positive with respect to the cathode during warmup time when the oscilloscope is first turned on. The neon does not glow when the oscilloscope has warmed up.

Bootstrap capacitor C668 improves the operation of the Miller Sweep Generator circuit in developing rapidly rising runup waveforms. To make the output sawtooth signal start at about zero volts, zener diode D675 is used to overcome the difference between V673A cathode voltage level and the desired level at the junction of D681 and R681.

To allow the A Sweep Generator circuit to reset quickly when the sawtooth has terminated, diode D681 is back-biased during the sweep retrace time to disconnect the diode-cathode circuitry from V673A cathode circuit. Diode D681 is normally conducting during the sawtooth runup and remaining portion of the holdoff period. C681 and R681 form a compensation network. C681 is adjusted to obtain best sweep linearity at the start of the sweep sawtooth when calibrating the fastest sweep rates.

Clamp Emitter Follower Q643 and Clamp Diode D677

In their quiescent state, Q643 and D677 are conducting to provide a DC feedback loop. This assures stable quiescent conditions. When tunnel diode D565 is triggered and the 9-V negative-going gate from the emitter of Q563 is applied to the emitter of Q643, transistor Q643 cuts off and diode D677 is reverse biased. These are the conditions while the sawtooth is generated.

Second A Sawtooth Cathode Follower V673B

The sawtooth output from the cathode circuit of V673A is applied to the grid of V673B in the Second A Sawtooth Cathode Follower stage. The purpose of this stage is to make the sawtooth available at the front-panel A SAWTOOTH connector while isolating the external loading from the internal sawtooth voltage.

Holdoff Multivibrator V625

The Holdoff Multivibrator V625 circuit prevents D565 from being triggered during the retrace interval. That is, the holdoff circuit allows a finite time for the Miller Sweep Generator circuit to reach a steady-state condition after the completion of a sweep.

Due to the many modes of operation of this stage, each mode is described separately as follows:

1. Quiescent State—Conditions: (Assume the A MODE switch is set to NORM). V625A is conducting and V625B is cut off. V625A cathode resets at about +12 V. Diodes D614, D616, D624, D635 and D678 are reverse-biased; D627 and D629 are conducting.

2. D565 Triggered—When tunnel diode D565 is triggered, the Miller Sweep Generator produces the positive-going sawtooth as explained earlier. At a certain point on the sawtooth ramp (about zero volts on the sample appearing at the wiper arm of the A SAWTOOTH AMPL control R678), diode D678 conducts and holdoff capacitor C675 charges. The sawtooth continues to rise and is coupled through D678 to the grid circuit of V625B.

When the rising sawtooth voltage reaches about +14 V at D678 cathode (see Fig. 3-13), V625B conducts, V625A cuts off and V625A cathode drops from +12 V to about —1 V. D616 conducts and D565 is driven to its low state but cannot be triggered while V625A is cut off. The sweep terminates, the retrace interval begins, D678 reverse-biases, and C675 begins to discharge resistors R637 and R639 for the SEC and MSEC positions of the A TIME/CM switch.

During the sweep retrace and holdoff time the holdoff capacitor continues discharging without interruption and holds V625B in conduction while the Miller Sweep Generator circuit resets and reaches its steady-state condition. As long as V625B is conducting, V625A is cut off and D565 cannot be triggered.

Finally, C675 becomes discharged to a point where V625B cuts off and V625A conducts. V625A cathode rises from —1 V to +12 V, D616 reverse-biases and this completes the holdoff circuit cycle. D565 is ready to be triggered once again.

Holdoff time is determined by the size of the holdoff capacitor and resistors R637, R639. The A TIME/CM switch SW660 is used to change the time constant of the holdoff circuit simultaneously with the change of timing capacitors and resistors. In the μSEC positions of the A TIME/CM switch, R637 and R639 are shunted by R675 to speed up C675 discharge.

The A SAWTOOTH AMPL control R678 determines sweep length by controlling the voltage level at which the sawtooth-ramp sample starts, since the end of the sample is always fixed by the point at which V625B conducts.

3. Single-Sweep Operation—Assume these beginning conditions: A MODE switch SW625 is set to SINGLE SWEEP, no triggers are applied to D565, and the RESET button is not pressed. Diode D635 is conducting and holding V625B in conduction and V625A is cut off. Under these conditions, the sweep circuit cannot be triggered. However, if the RESET button is pressed, a positive-going pulse will be applied through D624 to the cathode of V625B sufficient to cut off V625B so the multivibrator switches states; i. e., V625B cuts off and V625A conducts. Now the sweep is ready to start when D565 is triggered.

4. Right Plug-In Multi-Trace Unit Set For Alternate-Mode of Operation—Conditions: A MODE and B MODE switches are set to NORM, Upper Beam DISPLAY switch SW185 is set to RIGHT PLUG-IN A, the right plug-in is set for multi-trace alternate mode of operation (see Fig. 3-5), and the B sweep is set for a slower sweep rate than the A sweep. With no triggers applied to D565, V625A is conducting and V625B is cut off.

When triggers are applied to D565 and D765 (in the B Sweep Generator circuit), both sweeps start. As the A sweep sawtooth reaches the point where V625B conducts and V625A cuts off, D565 resets to its low state and the A sweep terminates. At this point, a 10 volt positive-going inhibit gate (from D1008 and D1010 in the Alternate Trace Logic circuit), is applied to the grid of V625B. This inhibit gate, equal in duration to the time difference between the end of the A sweep and the end of the slower-running B sweep, holds V625B in conduction, preventing D565 from being triggered.

Then, as the B sweep ends, the inhibit pulse ends simultaneously with the B gate sweep and allows holdoff capacitor C675 to discharge to the point where V625B cuts off and V625A conducts, D565 is now ready to be triggered once again.

The purpose of the inhibit gate is to lock out the A sweep until the B sweep terminates. Then, the combined action of A sweep in its locked-out condition and the B sweep resetting causes the Alternate Trace Logic circuit to produce one alternate sync pulse for switching the plug-in to the next channel. Then, the cycle is repeated as both beams display the signal in the second channel. To summarize the action, the Alternate Trace Logic circuit allows the plug-in to switch channels only when the slower sweep has completed its runup.

If the B sweep is set faster than the A sweep, the B sweep cycle is repeated until the A sweep ends, then the inhibit gate occurring at this time and lasting until the B sweep ends keeps the A sweep locked out until the B sweep resets. The Alternate Trace Logic circuit does not produce any alternate sync pulses while the A sweep is running up but, as explained eariler, the combined condition of locked-out A sweep and the B sweep going through its resetting action causes only one alternate sync pulse to be produced.

5. B Sweep Delayed-By-A Mode of Operation—Conditions: A MODE switch is set to NORM, B MODE switch is set to DLY'D BY A and the Upper Beam DISPLAY switch is set to RIGHT PLUG-IN A (similar to Fig. 3-6). Assume that the B sweep is set to last longer than the A sweep, and both sweeps have ended.

With no triggers applied to D565, V625A is conducting and V625B is cut off. When a trigger is applied to D565, the A sweep starts running up. At a certain point on the sawtooth ramp, (determined by the setting of the DELAY-TIME MULTIPLIER control) a delayed trigger from the Delay Pickoff circuit is applied to the B Sweep Generator circuit.

Assume that the B sweep starts automatically upon application of the delayed trigger. The B Sweep runs up and simultaneously generates a negative-going B gate. The B Gate Inverter circuit Q1004 (see Alternate Trace Logic & Blanking diagram) inverts the gate so it is positive-going and about 10 V in amplitude. This +10-V gate is now referred to as an inhibit gate. This gate is applied to the grid circuit of V625B. When the A sweep ends and V625B goes into conduction, V625A cuts off and resets D565 to its low state.

The inhibit gate holds V625B in conduction until the A sweep ends and Holdoff Capacitor C675 discharges to a point that causes V625B to cut off and V625A to conduct. Thus, the inhibit gate holds the A sweep locked out until the B sweep ends to prevent the intensified portion of the Upper Beam display from extending into the start of the A sweep.

6. B Single-Sweep Mode of Operation—This mode is similar to B Sweep Delayed-By-A mode, except that the B MODE switch is set to SINGLE SWEEP. The DELAY-TIME MULTIPLIER control and delayed trigger are not used in this Mode. With the Upper Beam DISPLAY switch set to RIGHT PLUG-IN A, the Holdoff Multivibrator operates as in the previously described mode; that is, the inhibit gate locks out the A sweep until the B sweep ends.

Reset Lamp Driver Q619 and Reset Lamp B619

The Reset Lamp Driver Q619 circuit with B619 is mainly used for single-sweep operation, so this mode is described first.

Assume these conditions: The A MODE switch SW625 is set to SINGLE SWEEP, no triggers are applied to D565 and the RESET button is not pressed. Under these conditions, D635 holds V625B in conduction when the sweep ends and V625A is cut off. The cathode of V625A will be at -1 V. This voltage, applied to the base circuit of Q619, holds Q619 cut off and B619 is turned off.

When the RESET button is pressed, C622 charges quickly toward $+10$ V, resulting in a positive-going pulse which is applied through D624 to the cathode of V625B. The pulse is sufficient to turn off V625B and V625A conducts. The cathode of V625A rises from -1 V to $+12$ V, Q619 conducts, B619 turns on, and D565 is ready to accept a trigger.

When D565 is triggered, the negative-going gate at the emitter of Q563 turns off Q619 and B619; also, as described earlier, disconnect diode D640 is reverse-biased and the sawtooth is generated. When the sawtooth drives V625B into conduction, V625A cuts off and the sweep is terminated. This ends the cycle of operation until the RESET button is pressed again.

If the A MODE switch is set to the NORM position, the RESET button is disconnected and D635 anode is connected to ground. Thus, toward the end of the sweep, holdoff capacitor C675 is able to discharge to a point where V625B cuts off, V625A conducts and the sweep ends. Transistor Q619 conducts, B619 turns on and D565 is ready to be triggered. When D565 is triggered, Q619 and B619 turn off and the cycle of operation is repeated. It is normal for B619 to stay on when the sweep duty cycle is low (sweep holdoff time is relatively long).

A Auto Multivibrator, Q605 and Q615

Transistors Q605 and Q615 with associated circuit components form a triggered monostable multivibrator that has two modes of operation when the A Triggering MODE switch SW505 is set to AUTO STABILITY. The two modes are: (1) non-triggered, and (2) triggered. Mode 1 is described first because it is the normal state of the multivibrator.

Mode 1 (Non-triggered). Transistor Q605 is conducting and Q615 is cut off. C611 has charged to approximately 25 V, determined mostly by Zener diode D612. Diode D614 is conducting and its current adds to the current through D565. This extra current causes D565 to be held at a threshold level that enables the Holdoff Multivibrator to switch D565 to its high state at the end of each sweep holdoff period. Thus, the A Sweep Generator will go into a free-running mode when trigger signals are absent.

Mode 2 (Triggered). Assume that all the conditions given for Mode 1 are present and 100-Hz or faster triggers are applied to T555 from D555. (Ignore for the moment that these same triggers are also applied to D565.) Under these conditions, the multivibrator will be triggered and will run through its natural period. For the following discussion the period is the minimum time that it takes for the multivibrator to be triggered, switch states, and then return to its original triggerable state.

Differential triggers from the secondary of T555 are applied to the base of Q605. Only the negative-going portion of one of the triggers actually triggers the multivibrator, so this is the only portion discussed here. The negative-going trigger feeds through the base-emitter junction of Q605, drives Q615 into saturation and Q605 cuts off. The collector of Q605 rises exponentially as C604 charges through R604 and R605. Finally, a point is reached where the decreasing charge current lowers the base of Q615, causing this transistor to cut off and Q605 to conduct. This completes the first half-cycle.

With Q605 conducting and Q615 cut off, C604 goes through its recovery time and C611 starts charging through R610 and R611. C604 exponential discharge current raises the base of Q615 to a point that will enable one of the triggers, feeding through the base emitter junction of Q605, to drive Q615 into saturation and Q605 will cut off. As Q615 goes into saturation, C611 is quickly discharged through the low impedance of Q615. Thus, the natural period for the multivibrator is short enough to limit the charge time of C611 well below the threshold level so zener D612 never breaks down, D614 never conducts, and D565 returns to its low state. The A Sweep Generator will stop free running when it (sweep generator) completes its cycle. From this point on, as long as triggers are applied to D565 from D555, these same triggers will trigger the sweep.

As Q605 is turning on and Q615 is turning off, D604 conducts to limit the negative-going swing on the base of Q615 to about -0.6 V or less. The negative-going swing is developed by the drop in collector voltage as Q605 turns on and by C604 as it starts its recovery.

As Q615 is driven into saturation, D602 conducts to assure rapid turn on of Q615 and to clamp its emitter.

If the triggers from D555 are slowly decreased in repetition rate from 100 Hz toward 30 Hz, the period of the multivibrator will be longer and C611 will change further. As a result, C611 charge will approach the threshold level for D565.

If the time between triggers is reduced to longer than 50 ms (trigger repetition rate slower than 30 Hz), Q615 will remain in its cut off condition for a time sufficient to allow C611 to charge to the level mainly determined by D612. When this point is reached, D614 conducts and D565 returns to the threshold level that enables the A Sweep Generator to free run.

When the A Triggering MODE switch is set to the TRIG position, the switch grounds the collector of Q615 and disables the automatic stability feature of the Type 556.

Upper Beam Unblanking Amplifier V574A

When the Upper Beam DISPLAY switch SW185 is set to the LEFT PLUG-IN A or RIGHT PLUG-IN A positions and the B MODE switch SW825 is set to NORM or SINGLE SWEEP, an unblanking pulse is generated for use in driving the Upper Beam CRT control grid circuit so that the Upper Beam is unblanked during the A sweep time. The unblanking pulse is initiated when tunnel diode D565 switches to its high state and produces a 9-V negative-going gate at the Q563 emitter (see Fig. 3-14A).

The 9-V negative-going gate at the emitter of Q563 is connected through the Upper Beam DISPLAY switch to the control grid circuit of V574A. The gate rapidly drives V574A into cutoff and the plate rises from +49 V to about +129 V (see Fig. 3-14B). Thus, a positive-going pulse about 80 V in amplitude is produced at the plate and applied to the grid of V583B. When the sweep ends, D565 is driven into its low state, V574A resumes conduction, and the 80-V unblanking pulse is terminated.

Diode D574 is forward biased during the time V574A is in a quiescent state. The feedback loop established with D574 conducting provides a stable quiescent voltage level at the cathode of V573B. The negative-going gate signal that is applied to the V574A grid to generate the unblanking signal, also reverse biases D574 and interrupts the fedback loop.

When a negative-going gate signal is applied to V574's grid, its plate voltage will rise until D799 is forward biased. Diode D799 is located in the B sweep generator circuit. When the B MODE switch is set to either NORM or SINGLE SWEEP, the voltage at the cathode of D799 is established at approximately +127 VDC by D796 and its associated circuitry. The V574A plate voltage rise is clamped at approximately +129 volts. When the B MODE switch is set to DLY'D BY A, the reference voltage at the cathode of D799 may be varied by the conduction of Q794.

When the B MODE switch is set to DLY'D BY A, +100 VDC is applied to the Upper Beam CONTRAST control, R793 and to the Lower Beam CONTRAST control, R853. With the +100 volts applied to R793, the bias of Q794 may be adjusted to reduce the amplitude of the Upper Beam unblanking signal (diminishing the trace brightness level), except during the time when a B gate signal from the plate of V783A is applied to the base of Q794. The B gate signal overrides the effect of the DC voltage from R793, and the Upper Beam unblanking signal is returned to its normal amplitude. Returning the Upper Beam intensity to normal during B sweep time (Upper Beam DISPLAY set to A) permits viewing the amount of delay between the start of the A sweep and the B sweep.

With a B delayed by A application where the A sweep is displayed on the Lower Beam, R853 may be used to adjust the bias of Q854 to provide a contrast in the Lower Beam intensity between the A and B sweep times.

Since the instruments with serial numbers 100-1999 do not have the capability of displaying the A sweep on the Lower Beam, only the Upper Beam CONTRAST control is incorporated. The contrast circuitry for these instruments is described as follows:

Set the B MODE switch to the DLY'D BY A position and assume the following conditions: Upper Beam DISPLAY switch is set to RIGHT PLUG-IN A, Lower Beam DISPLAY switch is set to RIGHT PLUG-IN B, the B sweep is operating faster than the A sweep, and the DELAY-TIME MULTIPLIER dial is set for a reading of about 3.00. Using these conditions to describe the unblanking pulse shown in Fig. 3-14C, the A sweep unblanking pulse will be produced in the usual manner, except V574A plate DC level at cutoff is controlled two ways:

1. The B MODE switch SW825 connects one end of the CONTRAST control R796 to +100 V, D796 is forward biased and D799 is reverse biased when the B sweep is not running. Thus, the CONTRAST control, rather than D799, determines the plate DC level during V574A cutoff when the B sweep is not running.

2. However, when the B sweep runs, its unblanking pulse is applied to the base circuit of Q793. The unblanking pulse causes D799 to conduct, D796 reverse biases, and V574A plate DC level is clamped at +129 V for the duration of the B unblanking pulse.

Thus, the CONTRAST control varies the non-intensified portions of the A unblanking pulse and the B unblanking pulse is used to restore the intensified portion of the A unblanking pulse to its normal (original) level. That is, if the Upper Beam INTENSITY control setting was set for suitable trace brightness during normal A sweep operation, the intensified portion reaches this same level during A Intensified by B operation.

When the Upper Beam DISPLAY switch SW185 is set to the LEFT PLUG-IN B or RIGHT PLUG-IN B positions and the B MODE switch SW825 is set to any position, the B sweep unblanking pulse is applied via the Upper Beam DISPLAY switch to the control grid circuit of V574A. The pulse is used to unblank the CRT Upper Beam during the B sweep in the same manner described for normal A sweep operation.

When the Upper Beam DISPLAY switch is set to either of the EXT positions, V574A grid is grounded through R574 and R575 to unblank the Upper Beam for external horizontal input operation.

A Sweep Unblanking Cathode Follower V583B

The 80-V positive-going unblanking pulse at the plate of V574A is applied to the grid of V583B in the A Sweep Unblanking C. F. stage. The output pulse obtained at V583B cathode is the same as the input but at slightly lower amplitude (about 76 V). This 76 volt pulse is coupled from V583B cathode through a network (in the CRT Circuit) to the CRT Upper Beam control grid. The unblanking pulse turns on (unblanks) the beam during the sweep time.

Capacitor C583 connected from the cathode of V583B to the plate circuit of V574A is a bootstrap capacitor. At the instant the unblanking pulse goes positive, the bootstrap capacitor helps to drive the plate of V574A positive. This action assures rapid turn-on of the beam at the start of the sweep.

Diode D581, connected from the cathode of V583B to the plate circuit of V574A, is a bootstrap diode. D581 turns on the instant the unblanking pulse goes negative to help drive the cathode of V583B downward. This action assures rapid turnoff of the beam at the end of the sweep.

A +Gate Cathode Follower V583A

The 14 volt positive-going pulse at the collector of Q563 is used by the A +Gate Cathode Follower V583A to provide a +gate waveform to the A GATE front-panel connector on the Type 556.

In its quiescent state, the control grid of V583A rests at about —4.4 volts. When the sweep runs, the 14 V pulse at Q563 collector is applied to divider resistor R586 and R587. Amplitude of the pulse at the junction of R586 and R587 is about 13 volts. The pulse drives the grid from —4.4 V to about +8.6 V. The output waveform at the cathode rises from ground to about 11 V for application to the front panel A GATE connector.

B SWEEP GENERATOR ⟨7⟩ and B SWEEP TIMING SWITCH ⟨8⟩

The B Sweep Generator and B Sweep Timing Switch circuit operation is the same as the corresponding circuits used in the A sweep except as follows:

1. There is no inhibit gate applied to the Holdoff Multivibrator circuit V825, but similar action takes place in this circuit when the B MODE switch SW825 is set to the DLY'D BY A position. In this position of the switch +10 V is applied to the grid circuit of V825B. This holds the V825B section of the multivibrator in conduction after the B sweep ends so the next B sweep cannot be generated until a delayed trigger pulse switches the multivibrator.

The delayed trigger is a 10 V short-duration positive-going pulse obtained from Q933 in the Delay Pickoff circuit. The pulse is generated at a predetermined time during each A sweep. When the pulse is applied via the B MODE switch to the junction of C823 and R822, and through D824 to the cathode of V825B, the pulse drives V825B into cutoff and causes the multivibrator to switch states. V825B is now cut off, V825A is conducting, and the B sweep is ready to be triggered in either of two ways.

(a) If the B Triggering MODE switch SW705 is set to the AUTO STABILITY position and there is no trigger from the B Sweep Trigger circuit, the B Auto Multivibrator circuit (Q805 and Q815) sets D765 threshold level so the B sweep starts immediately.

(b) If the B Triggering MODE switch is set to the TRIG position, a trigger from the B Sweep Trigger circuit applied to D765 will trigger the sweep. The B sweep will run once, lock out, and will not reset until the next delayed trigger arrives.

2. The B SAWTOOTH SLOPE adjustment R861 (see B Sweep Timing Switch diagram) permits adjusting the B sawtooth slope to match the A sawtooth slope.

Instruments SN 100-1999 have these additional differences in their A and B circuits.

3. Diode D778 with emitter follower Q799 provides the clamping action for V774A plate when V774A is driven into cutoff by the B gate. Thus, the plate voltage level during cutoff is about +128 V and this is essentially the same level as described earlier when D578 clamped the plate of V574A in the A Sweep Generator circuit.

4. The B Sweep Unblanking Cathode Follower V783B applies the trace brightening pulse through Q793 to V574A plate circuit located in the A Sweep Generator circuit. For further information about the operation of Q793 with associated circuitry containing D799, D796 and the CONTRAST control R796, refer to the Upper Beam Unblanking Amplifier V574A description.

DELAY PICKOFF ⟨9⟩

Refer to Figs. 3-6 and 3-15, and the Delay Pickoff schematic diagram during the following discussion.

The Delay Pickoff circuit generates a 10 volt short-duration positive-going pulse that is delayed from the start of the A sweep by an amount determined by the settings of the A TIME/CM (OR DELAY TIME) switch and the DELAY-TIME MULTIPLIER dial. The comparator in the delay pickoff circuit continuously monitors the sawtooth ramp voltage from the A Sweep Generator circuit and compares the ramp voltage with a DC voltage level established by the DELAY-TIME MULTIPLIER dial.

When the ramp voltage biases V904A into conduction, the comparator switches tunnel diode D905 to its high state. The tunnel diode generates a trigger pulse that is delayed from the start of the A sweep by the time it takes the ramp voltage to rise to a value approximately equal to the voltage established by the DELAY-TIME MULTIPLIER dial setting.

The trigger pulse from the tunnel diode is applied via T905 to a monostable Delayed Trigger Multivibrator so the trigger is regenerated into a fast-rise, high-amplitude, short-duration delayed trigger. The delayed trigger is applied internally via the B MODE switch to the B Holdoff Multivibrator V825 for use in the delayed B sweep mode of operation. The trigger is also applied to the DLY'D TRIG front-panel connector where it is always available.

Assume the Type 556 circuits are set for these conditions:

1. The B sweep is set to run faster than the A sweep.

2. The B MODE switch is set to DLY'D BY A.

3. The A Sweep Generator has reset and is ready to be triggered.

4. The B Sweep Miller circuit has run up and reset, D765 is in its low state but cannot be triggered because the B MODE switch is applying +10 V to the grid circuit of V825B. The +10 V holds this half of the multivibrator in conduction to lock out the B sweep. (Only a delayed trigger can make the multivibrator switch states so that the B sweep can be triggered as mentioned earlier.)

5. The DELAY-TIME MULTIPLIER control is set for a dial reading of 3.00. This is equal to 30 volts on the 105-volt A sweep sawtooth ramp; or, 3 cm from the start of the sweep having a total length of 10.5 cm.

With the A Sweep ready to be triggered, the quiescent conditions for all stages in the Delay Pickoff circuit are as follows:

(a) V904B, Q908 and Q924 are conducting.

(b) V904A and Q933 are cut off.

(c) D905 is in its low-voltage state.

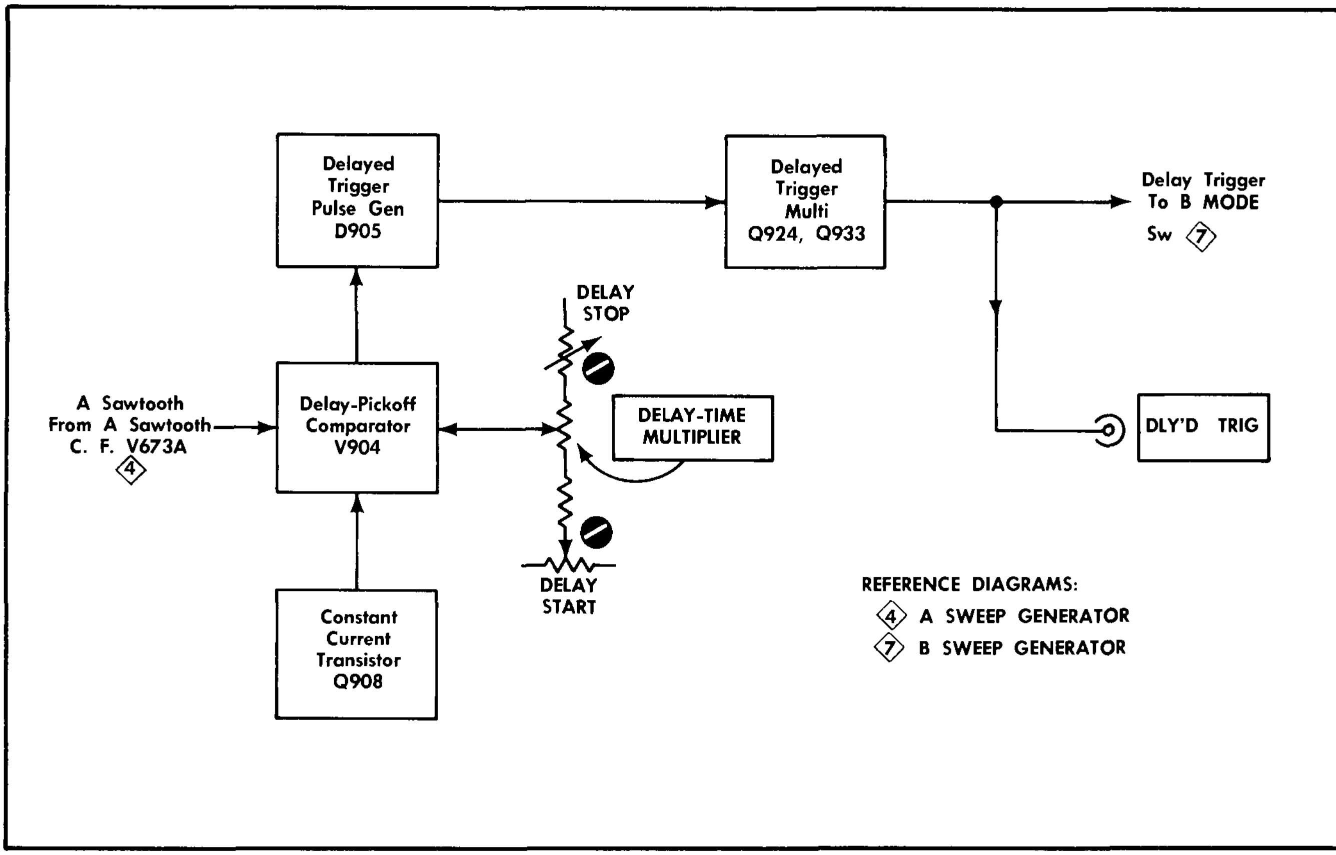


Fig. 3-15. Block diagram of Delay Pickoff circuit.

Constant Current Transistor Q908, Delay Pick-off Comparator V904 and Delayed Trigger Pulse Generator D905

Transistor Q908 is a constant-current source for V904A and V904B to keep the current through the Comparator relatively constant despite the large voltage swings applied to the grids. The base of Q908 is connected to ground and its collector rests at +34 volts. Emitter resistor R908 sets the current through Q908 and the Comparator at about 5 mA.

When the A sweep starts, the sawtooth ramp voltage is applied to the grid of V904A and the voltage selected by the wiper arm of the DELAY-TIME MULTIPLIER control R915 is applied to the grid of V904B. Assume the ramp voltage is increasing at the rate of 10 V/ms. Then, 3 ms after the sweep starts, the voltage on the grid of V904A will rise 30 V and will be equal to the voltage at the grid of V904B as set by the DELAY-TIME MULTIPLIER control.

At the point where V904A and B grids are equal, V904A conducts and draws current through R907 and tunnel diode D905. An increase in current through R907 results in a decrease through R909 and this push-pull current action causes D905 to switch to its high state. When D905 switches, a sharp trigger is developed in the primary of T905 and inductively coupled into the secondary. The dots above T905 windings on the schematic diagram indicate the + polarity end of the windings. To obtain a negative-going trigger to drive the base of Q924, the trigger is taken off at the negative end of the secondary winding.

When the sweep ends, V904A cuts off and returns D905 to its low state.

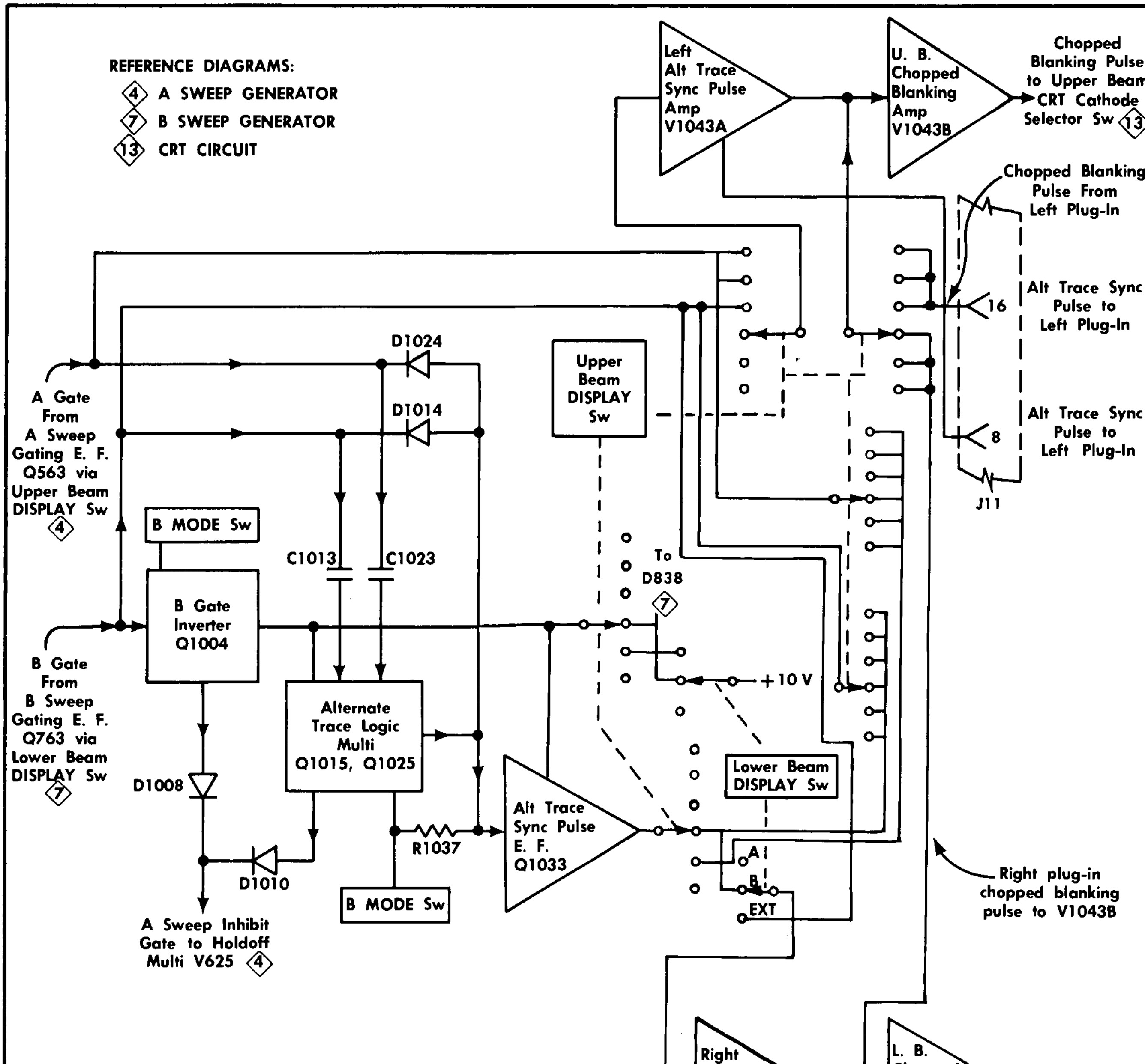
The Type 556 is calibrated so the major dial markings of the DELAY-TIME MULTIPLIER control correspond to the graticule divisions by correct adjustment of the DELAY START R918 and DELAY STOP R914 controls.

To eliminate ground-loop currents due to the remote location of the Delay Pickoff circuit, the coaxial shield of the cable from the A Sweep Generator is used as an isolated (from chassis) ground. The shield is connected to ground in the Delay Pickoff circuit through R900. V904B grid is referenced to the same isolated ground through C911.

Delay Trigger Multivibrator Q924 and Q933

The sharp negative-going trigger from T905 secondary is applied to the base of Q924. Transistor Q924 increases its conduction and Q933 turns on for the duration of the pulse. A fast positive-going trigger, rising from zero to +10 V, is produced at the emitter of Q933. This trigger is applied via the B MODE switch to the cathode circuit of V825B in the B Holdoff Multivibrator stage. The trigger causes V825B to cut off. V825A conducts to allow D765 to be triggered by the next trigger from the B Sweep Trigger or the B Auto Multivibrator (Q805 and Q815) to set D765 threshold level, depending on the settings of the B Triggering controls.

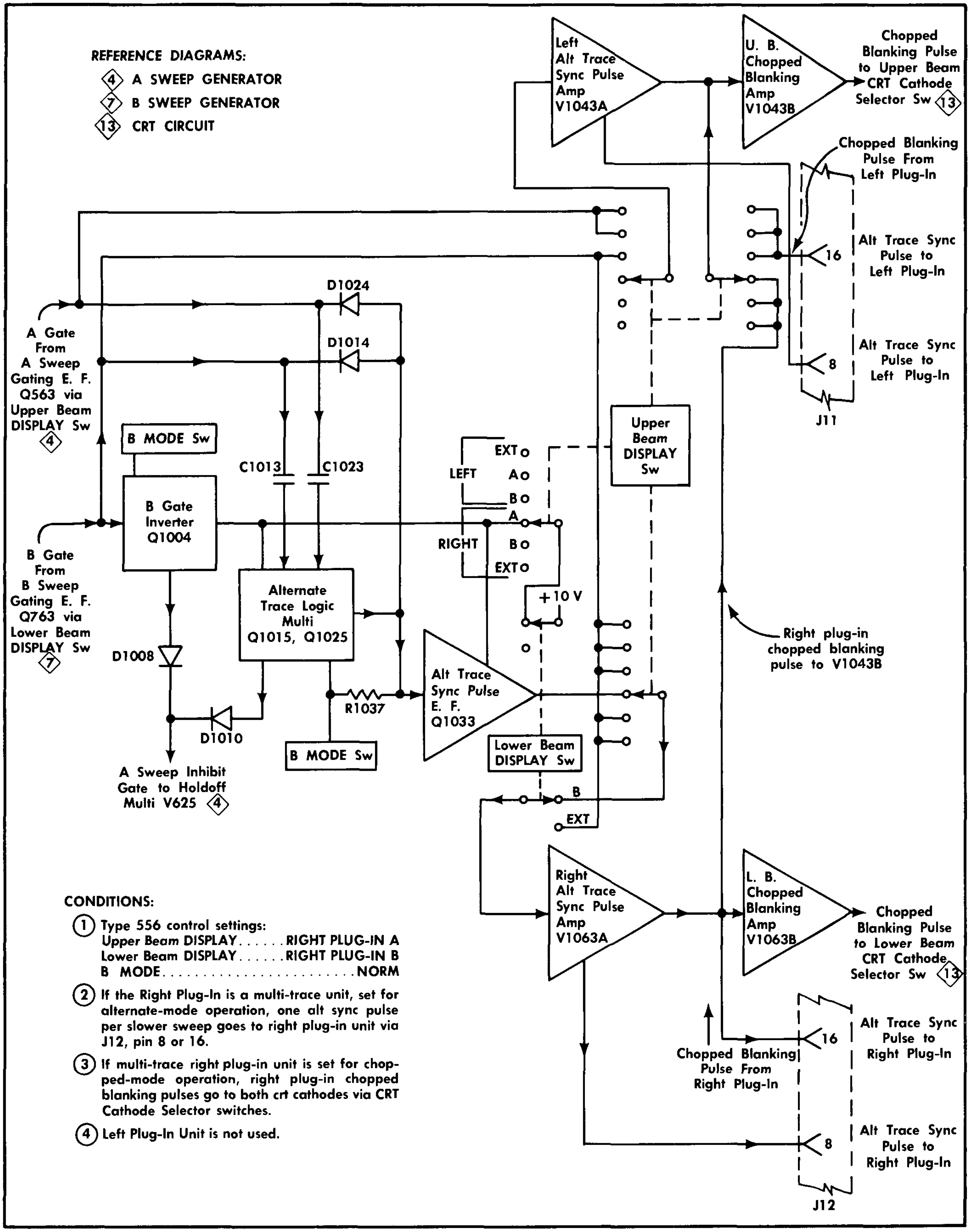
In addition, the trigger is applied to the DLY'D TRIG connector J935 on the front panel of the Type 556. This trigger is available for use in externally triggering other equipment.



CONDITIONS:

1. Type 556 control settings:
   Upper Beam DISPLAY......RIGHT PLUG-IN A
   Lower Beam DISPLAY......RIGHT PLUG-IN B
   B MODE........................NORM
2. If the Right Plug-In is a multi-trace unit, set for alternate-mode operation, one alt sync pulse per slower sweep goes to right plug-in unit via J12, pin 8 or 16.
3. If multi-trace right plug-in unit is set for chopped-mode operation, right plug-in chopped blanking pulses go to both crt cathodes via CRT Cathode Selector switches.
4. Left Plug-In Unit is not used.

Fig. 3-16. Block diagram of Alternate Trace Logic and Blanking circuits for Type 556 instruments with serial number 2000 and up.



CONDITIONS:

1. Type 556 control settings:
   Upper Beam DISPLAY . . . . . . RIGHT PLUG-IN A
   Lower Beam DISPLAY . . . . . . RIGHT PLUG-IN B
   B MODE . . . . NORM
2. If the Right Plug-In is a multi-trace unit, set for alternate-mode operation, one alt sync pulse per slower sweep goes to right plug-in unit via J12, pin 8 or 16.
3. If multi-trace right plug-in unit is set for chopped-mode operation, right plug-in chopped blanking pulses go to both crt cathodes via CRT Cathode Selector switches.
4. Left Plug-In Unit is not used.

Fig. 3-17. Block diagram of Alternate Trace Logic and Blanking circuit for Type 556 instruments with serial numbers 100 to 1999.

ALTERNATE TRACE LOGIC & BLANKING ⟨10⟩

Introduction

For this discussion, refer to the Alternate Trace Logic & Blanking schematic diagram (Fig. 3-16 and Fig. 3-17).

The Alternate Trace Logic & Blanking circuit can be divided into five smaller circuits according to purpose as follows:

1. B Gate Inverter Q1004. Purpose of this stage is to invert the negative-going B gate so the gate can serve as an inhibit gate for the A sweep during delayed-by-A and single-sweep operation. The inhibit gate locks out the A sweep until the B sweep ends to prevent the intensified portion of the Upper Beam display from folding over during right plug-in A display mode of operation.

2. Alternate Trace Multivibrator, Q1015 and Q1025. This stage provides the logic to operate a right plug-in multi-trace unit in the alternate mode during dual-beam operation. The sequence for proper logic is: Channel 1 (or A) signal is displayed simultaneously by both beams and then channel 2 (or B) signal is displayed by both beams, and so on.

3. Alternate Trace Sync Pulse Emitter Follower Q1033. This stage provides alternate trace sync pulse drive from D1014 and D1024 or Q1015 and Q1025 to V1063A.

4. Alternate Trace Sync Pulse Amplifiers, V1043A and V1063A. These stages amplify the alternate-trace sync pulses that are used to switch the channels in multi-trace plug-in units operating in the alternate mode. Channel switching occurs during the sweep retrace time.

5. Chopped Blanking Amplifiers, V1043B and V1063B. These stages amplify the chopped-blanking pulses coming from the multi-trace units operating in the chopped mode. These pulses blank the beams during the plug-in switching time from one channel to the next. Thus, the switching portions of the chopped display are not visible at normal settings of the INTENSITY controls.

B Gate Inverter Q1004

Operating conditions for this stage are: B MODE switch set to DLY'D BY A or SINGLE SWEEP, Upper Beam DISPLAY switch set to RIGHT PLUG-IN A, and the Lower Beam DISPLAY switch set to RIGHT PLUG-IN B. Assume the DELAY-TIME MULTIPLIER control and the B TIME/CM switch are set so the delayed B sweep terminates after the A sweep ends. Using these conditions while the B sweep is running, the 9 volt negative-going B gate from the Gating Emitter Follower Q763 in the B Sweep Generator circuit is applied through R1001 to the base of Q1004.

At the collector of Q1004 the gate pulse is a positive-going pulse about 10 V in amplitude. The pulse, now referred to as the inhibit gate, is applied through D1008 to the grid circuit of V625B in the A Holdoff Multivibrator stage of the A Sweep Generator circuit. When the A sweep ends, the inhibit gate holds the A sweep locked out until the B sweep ends.

If the right plug-in is a multi-trace unit that is set for alternate mode of operation, diodes D1014 and D1024 provide the logic for producing one alternate trace sync pulse per last sweep to end. To accomplish this logic, +100 V is applied to the collector circuits of Q1015 and Q1025 to disable the multivibrator stage and reverse bias D1021. As a result, diodes D1014 and D1024 are forward biased to permit the diodes to follow the DC levels of the incoming A and B gates.

When both sweeps are running concurrently, the gate from the last sweep that terminates is used to generate the alternate-trace sync pulse. For example, assume both sweeps are running; the DC level at the junction of D1014 and D1024 anodes will be at about the +1 V level and will remain at this level until the last sweep ends. As the last sweep ends, the positive-going portion of the DC level as it moves from +1 V to +10 V is used to generate the alternate-trace sync pulse required for switching the channels in the right plug-in multi-trace unit. Thus, for multi-trace delayed-sweep operation from the right plug-in unit operating in the alternate mode, there is always one A sweep and one B sweep per one alternate-trace sync pulse.

Alternate Trace Logic Multivibrator, Q1015 and Q1025

To establish the operating conditions for describing this circuit, assume the A and B MODE switches are set to NORM, the Upper Beam DISPLAY switch is set to RIGHT PLUG-IN A and the Lower Beam DISPLAY switch is set to RIGHT PLUG-IN B. Under these conditions, diodes D1024 and D1014 are reverse biased and not used; D1021 is always conducting.

Assume further that the sweeps have been triggered and are now running concurrently. With these conditions Q1025 is conducting and Q1015 is cut off. Diodes D1010, D1013 and D1028 are reverse biased; D1018 is conducting and clamps Q1015 collector at about −0.25 V. Diode D1023 is slightly forward biased and the collector of Q1025 is resting at about +10 V.

Assume the A sweep is ending first. As the A sweep ends and the A gate terminates (goes from +1 V to +10 V), the positive-going rise of this pulse is coupled through C1023 and D1023 to the base of Q1025. Transistor Q1025 is driven into cutoff and its collector is clamped at about +0.25 V by D1028.

With Q1025 cut off, the multivibrator action turns on Q1015, D1018 reverse biases and D1010 conducts to apply an inhibit gate to the A Holdoff Multivibrator stage. Thus, the A sweep is locked out and only the termination of the B gate can remove the inhibit gate and allow the A sweep to reset to its triggerable level; i. e., V625B is cut off and V625A is conducting in the A Holdoff Multivibrator stage to enable D565 to be triggered.

Assume the B sweep is now ending after the A sweep has ended. At the instant the B sweep ends, the B gate terminates and goes from +1 V to +10 V. The terminating B gate becomes a positive-going pulse when coupled through C1013 and this pulse drives Q1015 into cutoff. D1018 clamps the collector of Q1015 at −0.25 V. The multivibrator action causes Q1025 to conduct and D1028 reverse biases. As Q1015 goes into cutoff, D1010 is reverse biased and the inhibit gate is terminated to allow the A sweep to reset to its triggerable level. This completes one cycle of the multivibrator operation.

The signal generated at Q1025 collector is applied to the base of Q1033. The only portion of the signal that is used to produce an alternate-trace sync pulse is the portion generated when Q1025 turns on the instant the B sweep ends. This coincides with the combined condition of the A sweep locked out and the B sweep resetting. While the B sweep resets, the A sweep is allowed to reset and the alternate-trace sync pulse switches the right plug-in to the next channel. Thus, comparing this mode of operation to the operation of the B Gate Inverter stage previously described, the logic of the multivibrator circuit operation is such that the B sweep can run several times while there is only one A sweep and there will be only one alternate-trace sync pulse as shown in Fig. 3-18.

For the duration of the A sweep Q1025 is conducting and Q1015 is cut off. The positive-going portion of the B gate pulses, coupled through C1013 and D1013, will not base-trigger Q1015 because the transistor is already cut off. For the opposite situation, each time the B gate starts, the negative-going portion of the B gate pulses fail to reach the base of Q1015 because D1013 will not pass these pulses. As a result, Q1015 remains in cutoff while Q1025 is conducting and no alternate-trace sync pulses are generated while the A sweep is running.

Alternate Trace Sync Pulse Emitter Follower Q1033

This stage operates in conjunction with the B Gate Inverter and multivibrator stages to provide low-impedance sync pulse drive to V1063A.

Right Alternate Trace Sync Amplifier V1063A

With the Upper Beam DISPLAY switch set to RIGHT PLUG-IN A and the Lower Beam DISPLAY switch set to RIGHT PLUG-IN B, the alternate-trace sync pulse is applied to the grid circuit of V1063A. Coupling capacitor C1061 with R1060 forms a differentiating network for shaping the sync pulse. Diode D1062 clamps the negative-going portion of the pulse so only the positive-going portion is used as the sync pulse.

Both the cathode and plate circuits are completed through the switch connections in the right multi-trace plug-in unit operating in the alternate mode. In general, V1063A conducts only when the positive-going portion of the differential pulse is applied to the grid and the plug-in is operating in the alternate mode. V1063A is inoperative when operating in other modes. When V1063A is conducting, the alternate-trace sync pulse is either an amplified negative-going pulse when taken from the plate via pin 16 of J12, or is a small positive-going pulse when taken from the cathode via pin 8 of J12, if the tube is connected to operate as a cathode follower.

When the Upper Beam DISPLAY switch is set to any position except RIGHT PLUG-IN A, the B gate from the B Sweep Gating Emitter Follower Q763 is applied via the DISPLAY switch to the grid circuit of V1063A. Only the positive-going portion of the gate as it terminates is used to produce an alternate-trace sync pulse for switching the channels during the B sweep retrace time.

Left Alternate Trace Sync Pulse Amplifier V1043A

When the Upper Beam DISPLAY switch is set to LEFT PLUG-IN EXT or LEFT PLUG-IN A position, the A gate from the A Gate Emitter Follower Q563 is applied via the DISPLAY switch and C1041 to the grid circuit of V1043A. The function of the Left Alternate Trace Sync Pulse Amplifier stage is to provide an alternate-trace sync pulse via pin 8 or 16 of J11 to the left plug-in multi-trace unit during the sweep retrace time when the plug-in is operating in the alternate mode.

Operation of this stage is similar to the Right Alternate Trace Sync Pulse Amplifier stage. The sync pulse from V1043A is used to switch the channels in the left plug-in unit during the sweep retrace.

Lower Beam Chopped Blanking Amplifier V1063B

To avoid displaying the channel-switching portion of the vertical chopping signal when using a right plug-in multi-trace unit in the chopped mode, the beam is blanked during switching time between channels by the signal generated in the multi-trace unit. The negative-going chopped blanking pulses are connected to the junction of C1071 and R1065 through pin 16 of J12 of the right vertical interconnecting plug. The pulses are coupled through C1071 to the grid of the Lower Beam Chopped Blanking Amplifier tube V1063B. The signal is amplified and the inverted pulses are applied through the LOWER BEAM CHOPPED BLANKING position of the CRT Cathode Selector switch SW1345 (see CRT Circuit diagram) to the Lower Beam CRT cathode.

Note that the pulses applied to the junction of C1071 and R1065 are also applied through C1065 and a coaxial cable to the Upper Beam DISPLAY switch. When the switch is set to any of the RIGHT PLUG-IN positions, the negative-going chopped blanking pulses from the right plug-in unit are applied through the switch and coupled through C1051 to the grid of the Upper Beam Chopped Blanking tube V1043B for the purpose of blanking the Upper Beam display during the chopped-mode switching time between channels.

Upper Beam Chopped Blanking Amplifier V1043B

This amplifer serves the same purpose as the one for the Lower Beam; i. e., to provide chopped-mode blanking of the Upper Beam during chopped-mode switching between channels. When the Upper Beam DISPLAY switch is set to any of the RIGHT PLUG-IN positions, the chopped blanking pulses from the right plug-in are amplified by V1043B for application to the Upper Beam CRT cathode. The pulses to the CRT cathode are applied via the UPPER BEAM CHOPPED BLANKING position of the CRT Cathode Selector switch SW1395 (see CRT Circuit diagram).

When the Upper Beam DISPLAY switch is set to any of the LEFT PLUG-IN positions, the left plug-in chopped blanking pulses are used to blank the chopped-mode switching portion of the Upper Beam display. This occurs, of course, when the left plug-in is operating in the chopped mode. These pulses from the left plug-in are applied through pin 16 of J11 and

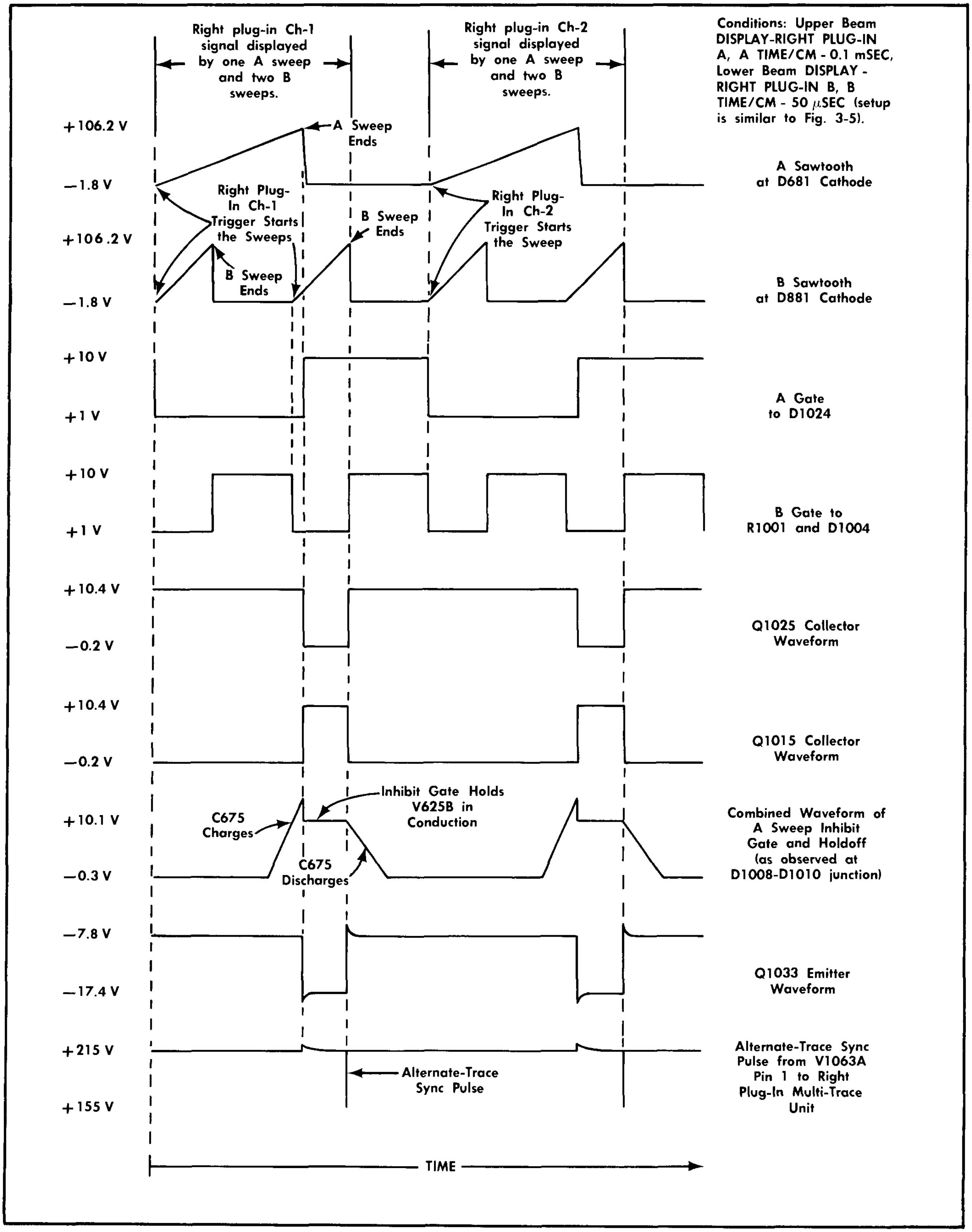


Fig. 3-18. Time-related waveforms showing how the A Sweep is locked out until the B Sweep ends. Note that only one alternate-trace sync pulse per slower sweep is generated for switching the channels in the right plug-in unit.

through C1051 to the grid of V1043B for amplification. The amplified and inverted pulses are applied through the UPPER BEAM CHOPPED BLANKING position of the CRT Cathode Selector SW1395 to the Upper Beam cathode of the CRT.

UPPER BEAM HORIZONTAL AMPLIFIER 11

The DC-coupled Upper Beam Horizontal Amplifier circuit (see Fig. 3-19) consists of Operational Amplifier Q1135, Q1145, Paraphase Amplifier Q1154-Q1164, push-pull Output Amplifier V1174-V1184, Capacitance Driver V1194, and External Horizontal Amplifier V1104.

The input signal for the Horizontal Amplifier is selected by the Upper Beam DISPLAY switch SW185. In the EXT positions the external signal, applied to the UPPER BEAM EXT HORIZ IN connector, is selected to drive the Upper Beam horizontal deflection plates. In the A positions of the switch the positive-going A sweep sawtooth provides the horizontal deflection, in the B positions the positive-going B sweep sawtooth provides the horizontal deflection.

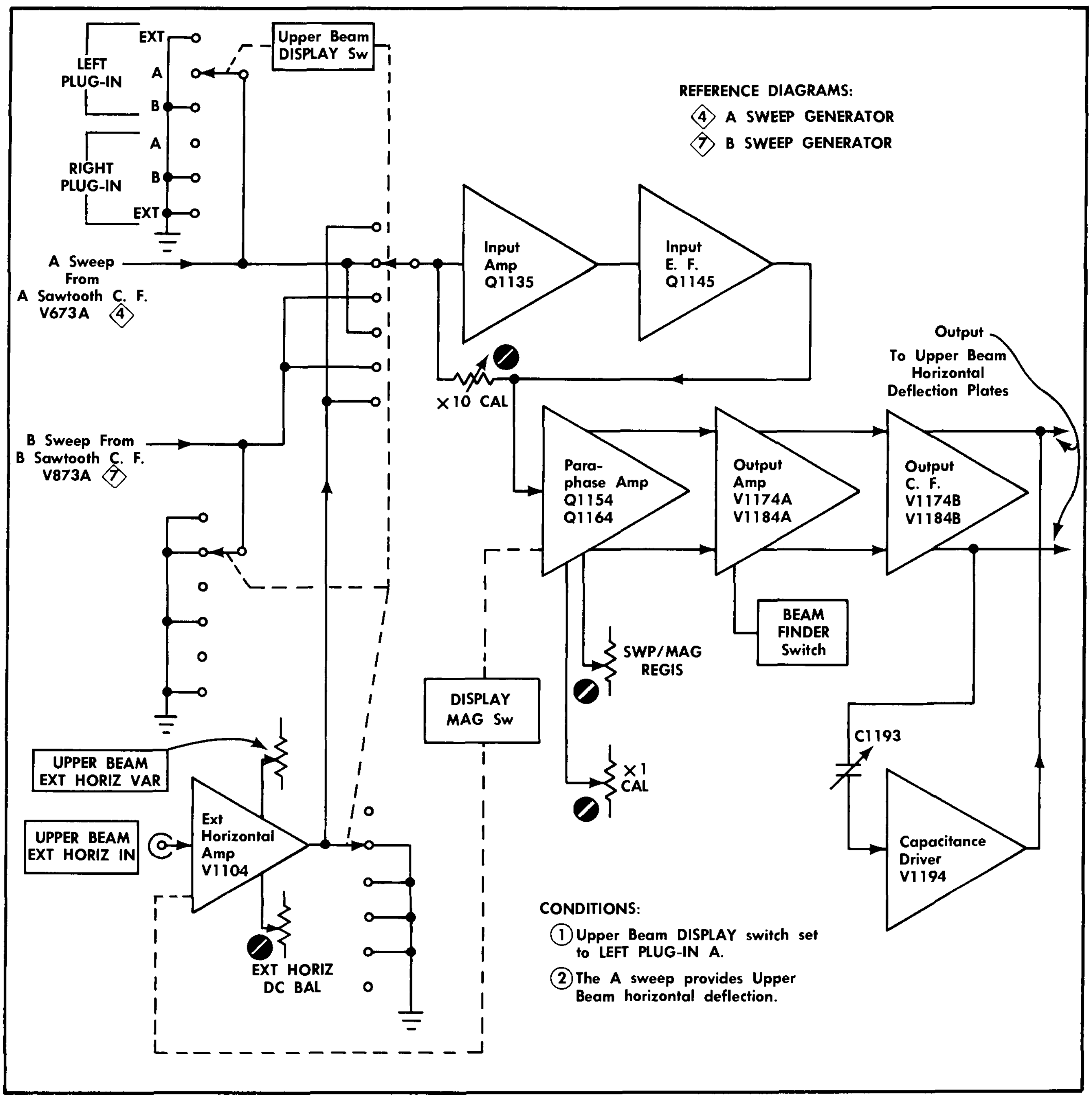


Fig. 3-19. Block diagram of the Upper Beam Horizontal Amplifier circuit.

Input Amplifier Q1135

The input signal selected by the Upper Beam DISPLAY switch, along with the DC positioning current from the horizontal POSITION controls R1136A and R1136B, is connected to the base of Q1135 in the Input Amplifier stage. This stage works together with Input Emitter Follower stage Q1145 to form an operational amplifier whose gain can be adjusted by the ×10 CAL control R1146 in the negative feedback loop. The Input Amplifier stage has a low input impedance and is current driven.

Horizontal positioning is provided by the POSITION controls, R1136A and R1136B. These controls are driven by the same shaft and they set the DC level of the input signal. Backlash coupling is used between the two sections of the POSITION control so both a coarse adjustment, R1136A, and a fine adjustment, R1136B, can be obtained by turning only one POSITION knob. Fine adjustment of the horizontal position is provided by R1136B operating in a 60° arc provided by the backlash coupling arrangement.

Negative feedback from the emitter of Q1145 to the base of Q1135 keeps the output impedance of the two stages low. The ×10 CAL adjustment provides a means of adjusting the amount of feedback, thereby controlling the gain when the DISPLAY MAG switch SW1120 is set to ×10.

Input Emitter Follower Q1145

The composite signal output (DC-positioning and signal current) from the collector of Q1135 is applied to a compensated divider network R1141, R1142 and C1141. The divider output is applied to the base of Q1145. Transistor Q1145 and associated components is an emittter follower, but the negative feedback to Q1135 makes the two transistors function as an operational amplifier. The output signal at the emitter of Q1145 is applied through D1151 to the base of Q1154. Diode D1151 is a protection diode. Resistor R1153 provides a bootstrap arrangement to restore the linearity of the sawtooth ramp. Zener D1144 sets the collector voltage at +25 V.

Paraphase Amplifier, Q1154 and Q1164

Transistors Q1154 and Q1164 with associated circuitry form a paraphase amplifier that converts the single-ended signal from the emittter of Q1145 into a push-pull output. The signal from Q1154 to Q1164 is coupled through the common emitter circuit. Gain of the stage is set by placing the DISPLAY MAG switch SW1120 to the ×1 position and adjusting the ×1 CAL control R1167 for proper 1 mSEC/CM sweep timing.

When the DISPLAY MAG switch SW1120 is set to the ×10 position, coil L1125 is energized to close its relay contacts (SW1125 on the Upper Beam Horizontal Amplifier diagram). These same contacts are closed when the Upper Beam DISPLAY switch SW1185 is set to either of the EXT positions. The contacts connect R1166 across the emitter resistors to decrease the emitter resistance of the stage and increase the display magnification by 10. To provide a front-panel indication that the DISPLAY MAG switch is set to ×10, SW1120 completes the circuit for B1120 so the incandescent lamp will turn on.

If switching the DISPLAY MAG switch between ×1 and ×10 causes a horizontal shift of the display, SWP/MAG REGIS control R1168 can be adjusted to prevent display shift.

Variable capacitor C1165 is adjusted for proper 0.1 μsec sweep timing when the DISPLAY MAG switch is set to ×10. Diode D1160 sets the base of Q1164 at about +0.5 V.

Output Amplifier V1174A and V1184A

The ramp voltage outputs from the collectors of Q1154 and Q1164 are applied to the control grids of V1174A and V1184A in the Output Amplifier stage. These two triodes amplify the ramp voltages, then the output is applied to the Output Cathode Followers, V1174B and V1184B.

To maintain the desired linearity at high sweep rates, part of the output is bootstrapped by the cathode followers through small variable capacitors C1172 and C1182. Diode D1182 conducts when the sweep resets to quickly return the beam to the left edge of the graticule.

BEAM LOCATE switch SW155, located in the cathode circuit of V1174A and V1184A, is a pushbutton switch. When pressed, the switch removes the short-circuit across R1179 to increase the common-cathode resistance and limit the current in the stage. The decrease in current limits the dynamic range of the stage so an off-screen display will appear on screen and the display location can be determined. B1178 is a protection neon that turns on during warm-up of the Type 556, thus limiting the grid-to-cathode voltages at that time.

Output Cathode Followers, V1174B and V1184B

The Output Cathode Follower stage, V1174B and V1184B, provides a low impedance push-pull drive to the Upper Beam horizontal deflection plates. Variable capacitors C1174 and C1184, together with stray capacitance across R1174 and R1184, form an adjustable high frequency feed-back network to obtain proper sweep waveshapes at high sweep rates.

Neons B1173 and B1183 limit grid-to-cathode voltage during the Type 556 warm up.

Capacitance Driver, V1194

The cathode of V1174B drives the left-hand deflection plate and, during the sweep, the cathode voltage should go linearly in a negative direction. At high sweep rates, when V1174B tries to drive the left-hand deflection plate negative, the deflection-plate capacitance and the output capacitance of cathode follower V1174B tend to distort the ideal linear ramp voltage into an RC discharge curve. To overcome this tendency toward non-linearity, the positive-going ramp voltage at the cathode of V1184B is applied through C1193 to the control grid of Capacitance Driver tube V1194.

The positive-going voltage on the grid of V1194 forces it into heavy conduction. The current supplied through the tube provides extra current to the cathode of V1174B and helps to discharge the capacitance in the V1174B output circuit. Since the CRT beam is blanked during the return trace, there is no need for a similar current driver for the cathode of V1184B.

External Horizontal Amplifier V1104

External signals for use in providing horizontal deflection of the Upper Beam are applied to the UPPER BEAM EXT HORIZ IN connector. In the ×1 position of the Upper Beam DISPLAY MAG switch SW1120, the signal is applied through the switch contacts and a compensated 10× attenuator to the grid of V1104A. The signal is attenuated 10× because the Paraphase Amplifier stage, Q1154 and Q1164, is already set for ×10 display magnification regardless of the Upper Beam DISPLAY MAG switch position. When the Upper Beam DISPLAY switch is set to either of the EXT positions, coil L1125 is energized, closing SW1125 relay contacts to provide the ×10 amplifer gain regardless of the DISPLAY MAG positions. Thus, to obtain a normal (×1) display, the X1 attenuator is used to reduce the amplitude of the signal by a factor of ten.

When the DISPLAY MAG switch is set to ×10, the signal is coupled directly (without attenuation) through the switch contacts to the grid of V1104A and the resulting horizontal deflection will appear as a ×10 magified display.

V1104A and V1104B form a cathode follower grounded-grid amplifier and the gain is controlled by adjusting the value of a coupling resistor connected in the cathode circuit. In this circuit, the variable coupling resistor is the UPPER BEAM EXT HORIZ VAR control R1108 which provides at least a 10:1 range of adjustment. The output of V1104B is applied through the DISPLAY switch to the base of Q1135.

Quiescent current through V1104B is adjusted with the EXT HORIZ DC BAL control R1110 to match the current through V1104A. With R1110 properly adjusted, there is no DC current flow in R1108 and R1105 with no signal applied. Thus, the UPPER BEAM EXT HORIZ VAR 1-10 control can be rotated without causing any horizontal shift in the position of the beam.

Variable capacitor C1115 provides a means of frequency-compensating the divider that is formed when the plate circuit of V1104B is connected to base circuit of Q1135.

LOWER BEAM HORIZONTAL AMPLIFIER 12

Except for differences in signal source selections, the Lower Beam Horizontal Amplifier circuit operates the same as the Upper Beam Horizontal Amplifier circuit. The signal source selections for the Lower Beam Horizontal Amplifier are: RIGHT PLUG-IN A, RIGHT PLUG-IN B and EXT.

Instruments with serial numbers 100-1999 do not have the RIGHT PLUG-IN A signal selection.

CRT CIRCUIT 13

The CRT in the Type 556 has two sets of vertical deflection plates and two sets of horizontal deflection plates, operated independently of each other. The CRT circuit consists of similar control circuits for the Upper Beam and the Lower Beam. The CRT Circuit consists of two major circuits that are similar to each other and controlled independently. One circuit is the Lower Beam and the other is the Upper Beam. However, the Lower Beam section contains additional circuits that control both beams. These are the high-voltage delay[1] and post-acceleration circuits. Fig. 3-20 is a block diagram that shows the Lower Beam CRT Circuit and those adjustments that are common to both beams. The CRT requires an accelerating potential of about 10,000 volts for both beams. Approximately 1850 volts of this is supplied by the CRT negative supply circuits and the remaining 8150 volts is provided by the Lower Beam post-acceleration circuit.

The —1850 volt supply for each beam consists of an oscillator, step-up transformer, rectifier and voltage regulator circuits. The description of these circuits refers to the Lower Beam section only but can be applied to the Upper Beam as well. Since the Lower Beam section contains additional circuits that affect both beams, these circuits are included in the description.

High-Voltage Oscillator V1300, Error Amplifier (V774B and V774C), and CRT Control-Grid Rectifier D1332

V1300 with associated circuitry comprises the high-voltage oscillator. V774B and V774C with their associated components are the error amplifiers. Output of the High-Voltage Oscillator is through T1301.

The High-Voltage Oscillator is a modified Armstrong circuit which operates at a frequency of about 35 kHz, determined mainly by the primary winding inductance of T1301 and the capacitance of C1303. Amplitude of the oscillator signal, and thus the amplitude of the rectified DC voltage is adjusted by changing the voltage on the control grid of V1300. This votage is controlled by the HIGH VOLTAGE adjustment R1332, through the Error Amplifier stage.

Transformer T1301 steps up the oscillator signal to the required voltage outputs. Diode D1332 provides half-wave rectification to produce the —1850 V. This negative DC high voltage is filtered by C1330, C1333, C1334 and R1339. Then it is applied to the CRT cathode and to a high-resistance voltage divider. The divider includes the FOCUS control R1336 and the HIGH VOLTAGE control R1332. When the HIGH VOLTAGE control R1332 is properly adjusted, the voltage at TP1340 is —1850 volts.

A portion of the —1850 V is fed back to the oscillator from the junction of R1331 and R1334 through the Error Amplifier stage for amplitude regulation. By comparing this voltage with the ground reference voltage at the cathode of V774C, any tendency of the rectified voltage to become more negative, for instance, would decrease the current through V774C and cause V774B grid to go less negative. This, in turn, would increase the current through V774B and R1302. With increased current through the resistors, the voltage at the control grid of V1300 goes more negative and thus would decrease the oscillator output amplitude to bring the rectifier output back to the correct value.

High Voltage Delay Q1334

The High Voltage Delay circuit consists of Q1334 and associated components. Purpose of this circuit is to gradually increase the high voltage while the instrument is warming up and the Lower Beam CRT circuit is stabilizing. The action of the delay circuit permits the Lower Beam to reach normal brightness at a slower rate than the Upper Beam.

[1]**Added in Type 556 SN 2000 and up.**

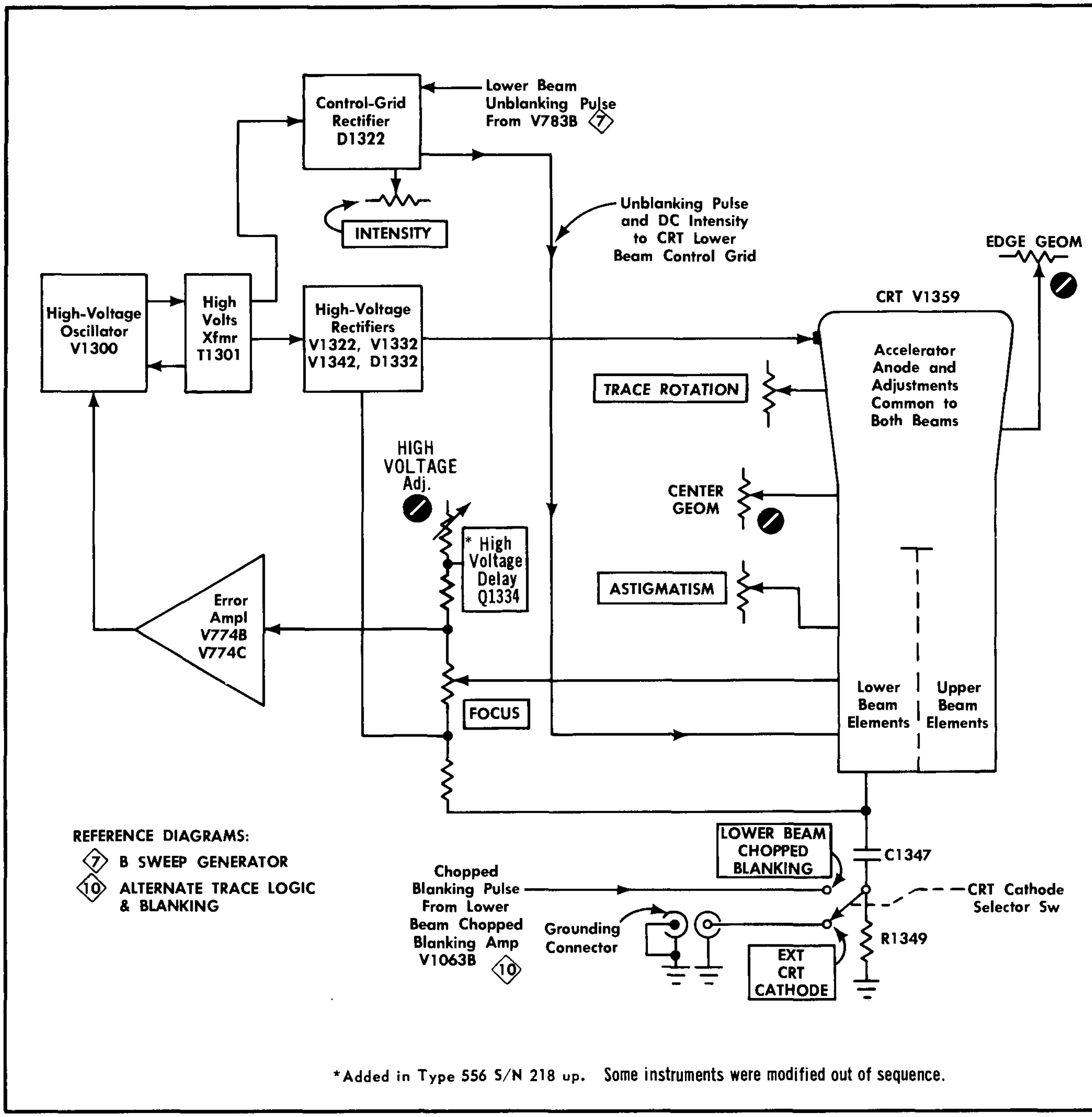


Fig. 3-20. Partial block diagram of CRT circuit showing the LowerBeam section and those adjustments that are common to both beams.

When the instrument is first turned on, Q1334 goes into saturation; D1334 and D1325 are reverse biased. The base current of Q1334 and the high-resistance path of R1323, R1325, R1326 and R1328 allow C1325 to change slowly. The change current keeps Q1334 froward biased and in saturation until the current begins to decrease as C1325 approaches full change. In about 20 seconds C1325 charge current has decreased to the point where D1325 becomes biased and Q1334 starts to come out of saturation.

As Q1334 comes out of saturation and starts to turn off, C1331 begins to charge. Charge current flows through the emitter-base junction of Q1334, and through resistors R1323, R1328 and R1329. As C1331 approaches full charge and the current decreases, Q1334 turns off and D1334 becomes biased. During the time that C1331 has been charging, the voltage level at the junction of R1330, R1331 and R1333 rises slowly, this action causes V774C grid voltage to go slowly less negative. Current through V774C increases, current through V774B decreases and V1300 control grid voltage goes less negative. As a result, the oscillator output amplitude is increased gradually as C1331 changes. Finally, when C1331 becomes fully charged, the voltages at TP1340 and the post-acceleration anode reach their normal level.

Total delay time is about 40 seconds. When the instrument is turned off, protection diode D1334 limits Q1334 emitter-to-base junction reverse bias by allowing C1325 to discharge through the diode.

Post-Acceleration Supply

A half-wave voltage tripler circuit, V1322, V1232 and V1342, rectifies the output from the associated secondary winding of T1301 to provide the dual-beam CRT post-acceleration potential of +8150 volts. Regulation of this voltage is provided through the transformer by regulation of the High-Voltage Oscillator V1300 output. Ground return for this supply is through the resistive helix inside the CRT to pin 9, through the R1392-R1393 divider resistors and to the +225-V and +100-V supplies.

CRT Control-Grid and Unblanking Circuit

As stated eariler, D1322 rectifies the high voltage from T1301 secondary winding (terminals 6 and 9). This rectified voltage provides the DC bias source for the CRT control grid. The front-panel Lower Beam INTENSITY control R1319 provides a means for manually adjusting the bias voltage applied to the Lower Beam CRT control grid and thus control the magnitude of the beam current. The range of the INTENSITY control varies the grid from about —1950 to —1870 volts.

As the control grid negative voltage is decreased (made less negative), the beam intensity is increased.

At the slower sweep rates the sweep unblanking signal from V783B in the B Sweep Generator circuit is applied through R1316, R1317, R1318, R1319 and R1320 to drive the Lower Beam control grid. The INTENSITY control R1319 is normally set so the Lower Beam does not light the phosphor of the CRT screen except during the positive portion of the sweep unblanking waveform.

At the fastest sweep rates, the stray capacitance of the floating control grid circuit makes it difficult for the grid to rise fast enough to unblank the CRT within the required time. A network consisting of R1316 and R1320 isolates the capacitive loading. By this arrangement, the fast leading edge of the unblanking pulse is coupled through C1321 and C1323 to the control grid of the CRT. For short-duration unblanking pulses such as those occurring at the fastest sweep rates, the DC levels on the rectifier D1322 and the associated secondary winding of T1301 are not appreciably affected. Longer unblanking pulses such as those that occur at the slower sweep rates, charges the stray capacitance in the control grid circuit through R1316. This pulls the floating grid up and holds the grid at the unblanked potential for the duration of the unblanking pulse.

CRT Circuit Controls and Connectors

Optimum size and shape of the upper beam as it is accelerated to the screen is obtained by adjusting the front-panel FOCUS and ASTIGMATISM controls. The FOCUS control R1366 provides the correct voltage for the second anode (focus ring) of the Upper Beam elements. Proper voltage for the third anode is obtained by adjusting the ASTIGMATISM control R1344. In order to obtain optimum spot size and shape, both the FOCUS and ASTIGMATISM controls are adjusted to provide the proper electronic lens configuration in the region of the second and third anodes. Spot intensity is adjusted by means of the front-panel INTENSITY control R1319. Varying the INTENSITY control changes the voltage on the CRT control grid, which in turn varies the density of the electron stream. Internal CENTER GEOM R1342 and EDGE GEOM R1391 controls adjust the isolation and edge shield voltages to minimize bowing of the display. The front-panel TRACE ROTATION control, R1390A and R1390B, permits minor adjustment in trace orientation. By adjusting the TRACE ROTATION control, the traces for both beams can be made parallel with the horizontal center lines on the internal graticule.

Lower Beam CRT Controls

The EXT CRT CATHODE BNC connector on the rear panel of the Type 556 provides an input for externally modulating the Lower Beam CRT cathode. The connector is normally grounded by a grounding cover. To intensity modulate the display from an external source, the grounding cover is disconnected from the BNC connector, the CRT Cathode Selector switch SW1345 is set to the EXT CRT CATHODE position, and the modulating signal is coupled to the Lower Beam CRT cathode through C1347.

When the Type 556 is used with multi-channel vertical plug-in units that provide multi-trace chopped blanking pulses, the blanking pulses are applied to the CRT Cathode Selector switch SW1345. With the plug-in unit operating in the chopped mode and SW1345 set to the LOWER BEAM CHOPPED BLANKING position, a positive pulse of about 20 volts amplitude is applied through C1347 to the cathode of the Lower Beam. At normal intensity levels, this pulse is sufficient to cut off the CRT during the time the channels in the plug-in unit are switched.

Upper Beam CRT Circuit

Except for the dual-beam post-acceleration supply and the high-voltage delay circuit included in the Lower Beam section, the Upper Beam CRT circuit is the same. For the Upper Beam, there is an additional signal which is combined with the unblanking pulse for controlling the trace unblanking levels. This additional signal, as explained earlier in the Upper Beam Unblanking Amplifier V574A description, restores the beam to its normal intensity level for the duration of the B sweep when using delayed-sweep mode of operation. This intensity level is referred to in this manual as the intensified portion of the Upper Beam display.

In delayed-sweep mode of operation, the front-panel CONTRAST control (see B Sweep Generator circuit) is used to control the brightness of the non-intensified portions of the trace and the INTENSITY control R1369 is used to set the overall level including the intensified portion of the display.

POWER SUPPLY ⟨14⟩ and HEATER WIRING ⟨15⟩

General

The low-voltage power supply provides the operating power for the instrument from four regulated supplies: —150 V, +100 V, +225 V and +350 V. Electronic regulation is used to provide stable output voltages. Each supply is fuse-protected against overloads.

An unregulated +6 volt supply is provided to operate the Reset Lamp Driver stages Q619 and Q819, and for powering the incandescent indicator lights B619 and B819. Unregulated 6.3 V and 12.6 V RMS AC voltages are provided for operating the tube filiments (including the dual-beam CRT), POWER pilot light and graticule lamps.. The 6.3 V is also the line triggering source for the A and B Sweep Trigger circuits.

All of the power-supply DC regulator circuits operate similarly. A sensing circuit compares a sample of the output voltage against a fixed reference voltage. Any difference between the output voltage and the reference produces an error signal which is amplified and applied to the series regulator transistors, causing the regulators to correct for the error and return the output to the proper value. Fig. 3-21 is a block diagram of the Power Supply circuit (Fig. 3-22 for SN 100-1999).

Power Transformer

The power transformer T1401 is enclosed in a special metal shield to reduce the effects of electromagnetic interference in the other circuits. The transformer windings ar shown schematically on the Power Supply diagram in Section 9.

When line voltage is applied to the instrument, the current path through the primary circuit is through line filter FL1400, POWER switch SW1402, thermal cutout TK1404, fuse F1401 or flses F1401 and F1402, and through both primary windings. When the instrument is configurated for a 115 volts (nominal) application, only fuse F1401 is used, with a 230 volts (nominal) application, fuse F1402 is added to the circuitry.

To provide optimum voltage regulation and correct DC voltage levels with any applied line voltage within the ranges of 90 to 136 VAC and 180 to 272 VAC, the primary is constructed as two identical windings, each with three taps to permit selection of different turns ratios. The desired transformer turns ratio is selected by positioning the Voltage and Range Selectors (located in the Line Voltage Selector Assembly). The two windings are connected in parallel when the Voltage Selector is set to 115 V and in series when the selector is set to 230 V. The position of the Range Selector (LO, M, HI) determines which taps on the two windings are selected.

For instruments with serial numbers 100-1999, the transformer primary circuit configuration is as follows:

One winding connects to terminals 1 and 3, the other connects to terminals 2 and 4. There are two more windings which may be used as voltage bucking or aiding windings. These are connected to terminals 5 and 6 for one winding and terminals 7 and 8 for the other winding. These windings along with the two main primary windings may be used to allow the instrument to run on nominal line voltages of 104, 115, 208, and 230 volts, depending upon how all the windings are connected. Square pin connectors on a power circuit board simplify the connections of leads and connectors when changing line-voltage operation.

Thermal cutout switch TK1404 is provided to protect the instrument from excessive heating. When its ambient temperature exceeds approximately 140°F, the thermal cutout switch will open the transformers primary circuit, Since the switch will close when its ambient temperature drops below its opening temperature, and restore line voltage to the primary, always set the POWER switch to OFF before attempting to remedy an overheated instrument condition.

The fan must be operative when power is applied to the instrument to adequately circulate the cooling air. Since the fan motor is connected across one of the primary windings. power is applied to the fan motor when it is applied to the primary windings and the fan rotation speed is not affected by changes to the transformers turns ratio.

The transformers output windings are the voltage source for five full wave rectifier circuits and one 6.3 VAC circuit.

DC VOLTAGE SUPPLIES SN 2000-up

—150 Volts Supply

A block diagram of this circuit is shown in Fig. 3-20. The —150 Volts Supply circuit contains a rectifier in the form of a diode bridge (D1482) connected to one of the secondary windings of T1401; a variable resistance network that contains the —150 volts output level adjustment R1498; a comparator circuit (Q1484 and Q1494) that senses any change in the output voltage level with respect to ground and two emitter followers (Q1504 and Q1513) that connects the output of the comparator circuit to 2 series regulator (Q1517). The series regulator circuit (Q1517) provides the necessary voltage compensations to maintain the output level at —150 volts.

Q1484 and Q1494 with their associated circuitry form the voltage comparator circuit. The constant plate to cathode voltage of glow discharge tube. V1482 is used to fix the voltage at the base of Q1484 with respect to the negative side of the rectifier bridge or output of the —150 supply. The base of Q1494 is connected to a variable resistance network that includes the —150 volts adjustment R1498. Since this resistance network is connected between the —150 supply circuits output and ground, the Q1494 base voltage level set by R1498 is referenced to ground. With the base voltage of Q1484 fixed with respect to the output voltage and the base voltage of Q1494 following any change in output voltage with respect to ground, the division of currents through Q1484 and Q1494 will vary with any output voltage change in respect to ground. The changes in the division of currents through the two transistors will cause voltage changes in both collector circuits, but only the voltage changes, or error signals, developed in the Q1494 collector circuit are coupled by the emitter follower circuits to the series regulator circuit.

During instrumnt calibration, the —150 volts adjustment, R1498, is set to establish a division of currents through Q1484 and Q1494. This produces a Q1494 collector voltage which sets the Q1504, Q1515 and Q1517 bias voltages, producing

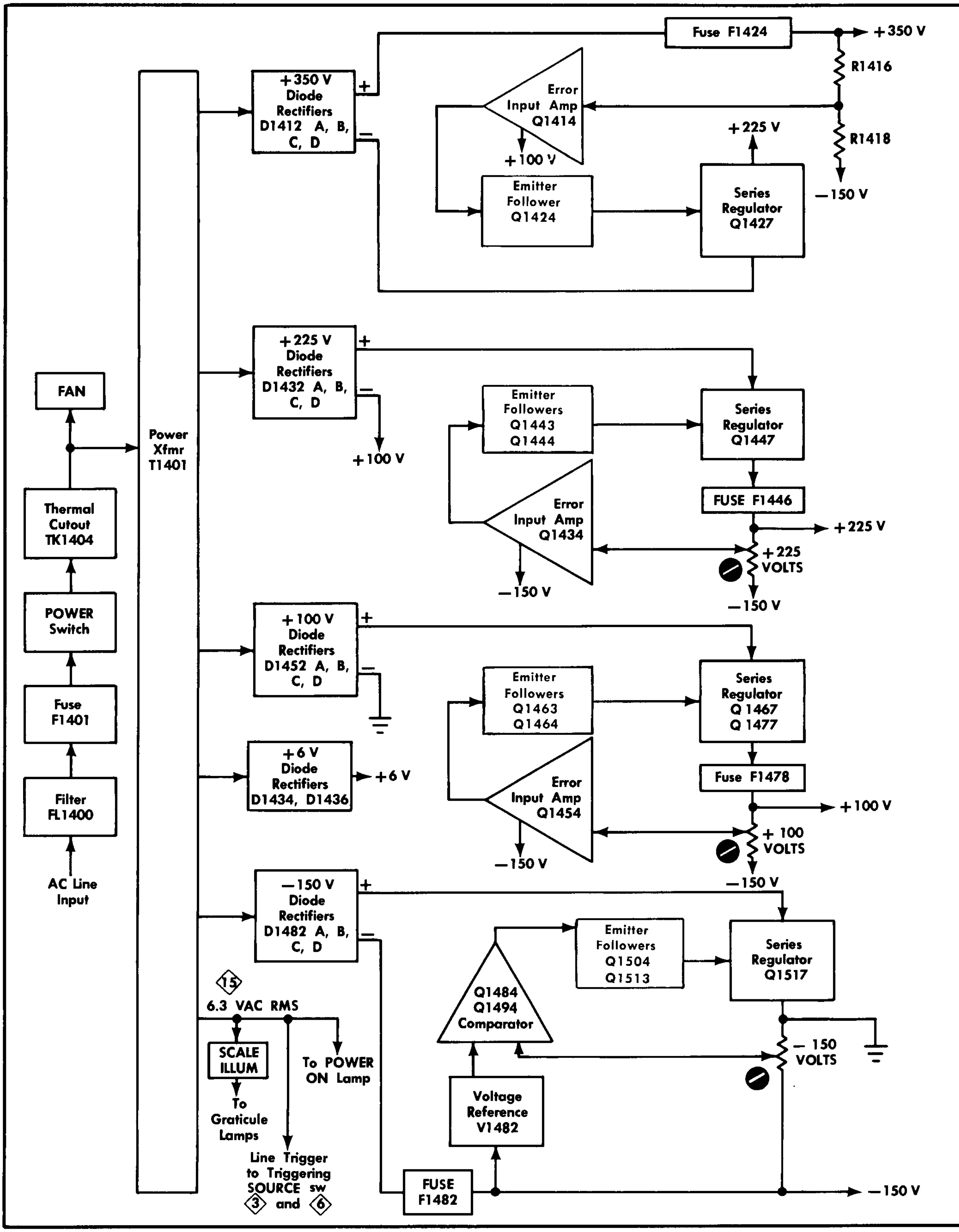


Fig. 3-21. Block diagram of Power Supply circuit and partial circuit of Heater Wiring for the Type 556 SN 2000 and up.

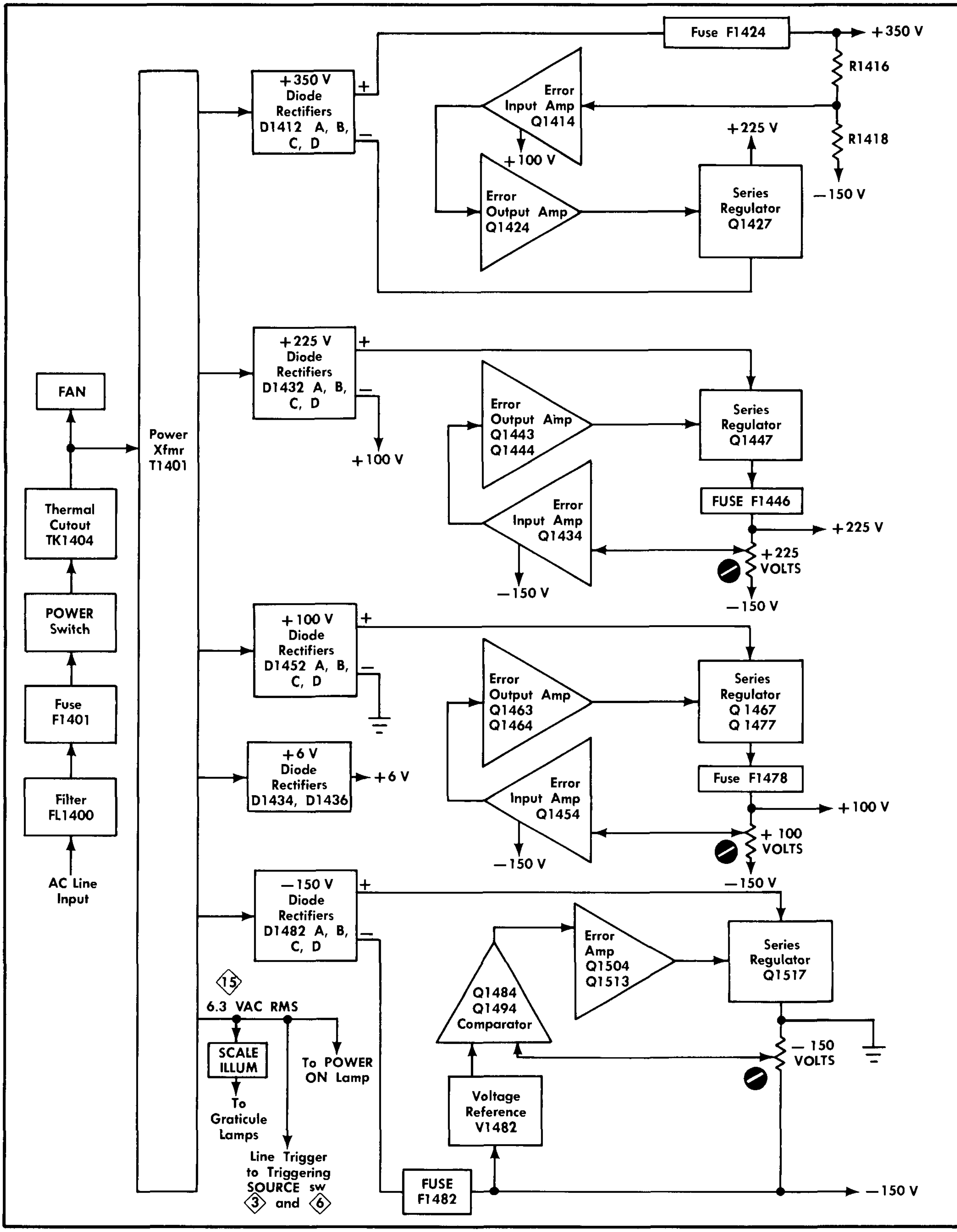


Fig. 3-22. Block diagram of Power Supply circuit and partial circuit of Heater Wiring for the Type 556 SN 100 to 1999.

a Q1517 collector to emitter drop which equals the difference between the rectifier output voltage and 150 volts. When the regulator circuitry is adjusted to produce —150 volts for a given rectifier output, any change in output voltage with respect to ground causes a bias change on Q1494 of opposite polarity to the output voltage, and of about one half the amplitude. For example, if the —150 volts output began to increase toward —151 volts, the voltage at the emitter of Q1494 would become more negative by approximately the unit of voltage change (due to the constant voltage across V1482), while the voltage at the base of Q1414 would become more negative by approximately one-half the unit of voltage change (due to the voltage divider action of the resistance network), resulting in an increase in forward bias of approximately one-half the unit of voltage change.

Q1504 and Q1513 with their associated circuitry form two emitter follower circuits. Error signals developed in the collector circuit of Q1494 are coupled to the base of Q1517 via these two emitter followers. The two emitter followers provide isolation between the error sensing circuit and the series regulator. The associated circuitry is configured to provide error signal limiting for regulator circuit protection and to provide phase shifting to prevent self-inflicted regulator circuit oscillations.

Q1517 and shunt resistor R1519 form a series regulator circuit. The circuit functions as a variable resistance in series with the —150 volt load circuits. Any change in the rectifier output voltage, whether due to line voltage or load current changes, is compensated by an equal change in voltage across the series regulator circuit.

Since the compensating changes in voltage across the series regulator are reactions to changes in the output voltage with respect to ground, there is a temporary change in output voltage during the regulator circuit reaction time. Filter capacitors C1498 and C1499, connected between the —150 volts output and ground, suppresses the effects of these voltage changes to a level negligible to the operation of the instrument.

Fuse 1482 will open when the current through it exceeds approximately .75 amperes. Since an excessive current must be present for a finite interval before F1482 will open, R1517 is provided to limit surge currents through Q1517 to a level within the transistor's dissipation capabilities.

+100 Volt Supply

The input to the +100 V supply is the output of the secondary winding connected to terminals 13 and 14 on the power transformer T1401 and the silicon diode bridge D1452. In addition to its other loads, the +100 V supply provides current to the +225 V supply and then through the 225 V supply to the 350 V supply. Also, the +100 V supply must provide a total current of 300 mA to two series strings of filaments (see the Heater Wiring diagram). The plug-in units become part of the series filament string. If the plug-in units are removed while the oscilloscope is operating, the +100 V supply is capable of remaining within its dissipation limits despite the 300 mA change in load.

The configuration of the +100 Volt Supply regulator circuit and its reaction to a change in output voltage is similar to the —150 Volts supply regulator circuit.

Q1454 with its associated circuitry forms the error sensing circuit. The base of Q1454 is connected to a resistance network that includes the +100 volt output adjustment R1459. Since R1459 is connected between the +100 Volt output and the regulated —150 Volt output, any change in the +100 volts with respect to the —150 Volts is applied as a change signal to the base of Q1454. D1450 provides thermal compensation for Q1454 and reference to ground.

Q1463 and Q1464 with their associated circuitry form a circuit similar in configuration and function to the circuit formed by Q1504 and Q1513 in the —150 Volt supply circuit.

Q1467 and Q1477 are connected in parallel and with the shunt resistors R1476, R1477 and R1478 form the series regulator circuit.

Fuse F1478 and current limiting resistors R1464 and R1469 protect the circuit from excessive currents.

+225 Volt Supply

The AC output of the secondary windings between terminals 15 and 16 is rectified by diode bridge D1432 and added to the +100 volt supply output to produce the +225 volts supply.

The +225 volts supply is similar in configuration and operation to the +100 volts supply. Q1434 with its associated circuitry forms the error sensing circuit. D1430 provides +100 reference and temperature compensation for Q1434 and R1430 is the +225 Volt output adjustment. Q1443 and Q1444 with their associated circuitry form the emitter follower circuits. Q1447 with the two shunt resistors R1445 and R1446 form the series regulator circuit. The regulating circuit is protected by fuse F1446 and current limiting resistors R1442 and R1443.

+350 Volt Supply

The AC output of the secondary windings between terminals 19 and 20 is rectiifed by diode bridge D1412 and added to the +225 volts supply through the series regulator (Q1427) to produce the +350 Volt supply.

Q1414 with its associated circuitry forms the error sensing circuit. The base of Q1414 is connected to the junction of two equal value resistors. Since these two resistors are connected between the +350 Volts output and the —150 Volt output, about one-half the amplitude of any change in the +350 Volts with respect to the regulated —150 Volts is applied to the base of Q1414.

Q1424 with its associated circuitry forms an emitter follower circuit that provides isolation between the error sensing circuit and the series regulator circuit. The output of Q1424 is the signal drive for Q1427 in the series regulator circuit.

Q1427 and shunt resistor R1427 form the series regulator circuit. Current limiting for Q1427 is provided by R1429.

In the event of a circuit malfunction, the +350 V supply circuitry is protected from excessive currents by F1424 and the output supply voltage is prevented from decreasing substantially below the +250 volts supply level by D1440.

The power supply circuits in instruments SN 100-1999 are configurated similarly to the circuits described above. They produce the same output supply voltages and the supply voltages and are regulated in essentially the same manner. In general, components in the two power supply configurations that have the same circuit designations, provide the same or a similar function. The notable circuit differences are, the transistors used in the four series regulator circuits are PNP germanium instead of NPN silicon; modified Darlington amplifiers instead of emitter follower circuits connect the output of the error sensing circuits to the series regulators in the —150, +100 and +250 Volt supplies and a voltage amplifier instead of an emitter follower connects the error sensing circuit to the series regulator in the +350 Volt supply.

CALIBRATOR ⟨17⟩

The Calibrator circuit in the Type 556 is a 1 kHz square-wave generator (see Fig. 3-23 and the Calibrator schematic) that provides both voltage and a 5 mA current output to the front-panel connectors. The voltage output is taken from the CAL OUT connector on the front panel, where either a square wave or a steady +100 V DC reference voltage is available.

By rotating the AMPLITUDE CALIBRATOR switch SW1630, the amplitude of the square wave output may be varied from 0.2 mV to 100 V peak to peak. The current output is applied to the loop marked 5 mA, with the arrow indicating conventional current flow. When the AMPLITUDE CALIBRATOR switch is set to the 100 V DC position, the loop has 5 mA DC flowing through it. When the switch is set to the 5 mAΩ position, the current through the link is in the form of a 1 kHz, 5 mA square wave.

CAUTION

The loop is designed for use with a snap-on current probe and does not unplug.

Calibrator Multivibrator, V1605A and V1605B

The square-wave generator is an astable multivibrator using two sections of a three-section tube. V1605A and V1605B are the multivibrator sections with the pentode section (V1605A) connected as a triode. The value of the plate load resistor R1605 is relatively lower than the value of V1605B plate load resistor R1615 so the current drawn through the sections during conduction will be nearly the same and constant current will be drawn from the —150 V supply.

When the amplitude calibrator is turned on, the multivibrator cathodes are returned through R1602 and R1601 to the —150 V supply. Capacitor C1602 bypasses any fast switching transients that may appear at the cathodes. The plate of V1605A operates from the +100 V supply while the plate of V1605B operates from the +225 V supply. The plate of V1605B swings from about —2 volts to about +143 volts. The output voltage from the plate of V1605B is coupled through R1620 and the CAL AMPL control R1628 to the grid of the cathode follower section, V1605C.

Calibrator Output Cathode Follower V1605C

The Calibrator Multivibrator stage switches the Calibrator Output Cathode Follower section, V1605C, between cutoff and conduction. During the negative portion of the multivibrator output waveform, the grid of V1605C is driven well below cutoff and its cathode rests at ground potential. During the positive portion of the waveform, V1605C is driven into conduction and the cathode potential is +100 V, set accurately by the CAL AMPL control R1628, the clamping action of D1620, and the precise setting of the +100 V supply.

Accurate adjustment of the CAL AMPL control is made by setting the AMPLITUDE CALIBRATOR switch SW1630 to 100 V DC and then adjusting R1628 for exactly +100 V output at

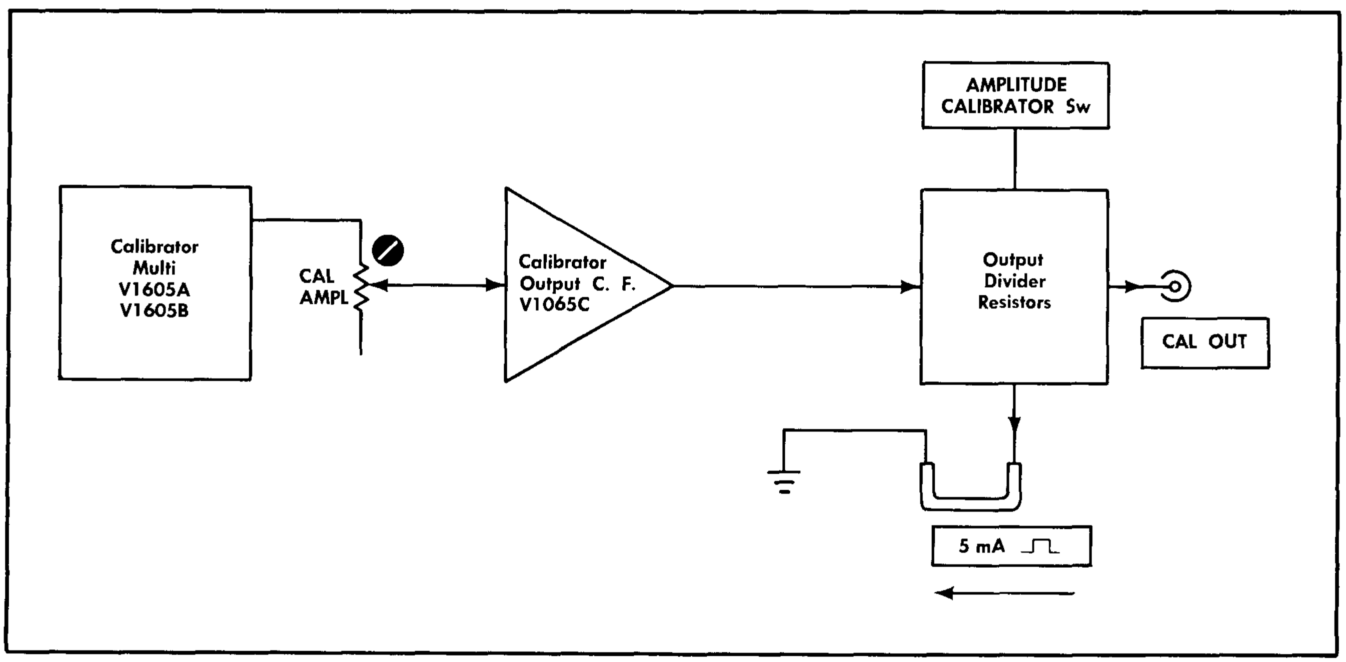


Fig. 3-23. Block diagram of the Calibrator circuit.

the CAL OUT connector. With the switch set to 100 V DC, the Calibrator Multivibrator stage is disabled because the cathode return circuit is disconnected from —150 V. Diode D1620 conducts and clamps the junction of R1620 and R1628 at about 0.6 V higher than the +100 V supply voltage. Thus, V1605C is held in conduction at the same level as that obtained when the multivibrator is operating and V1605B plate is at its most positive level. With V1605C grid held at a constant DC level and with the +100 V supply previously adjusted for proper output, the CAL AMPL control R1628 can be easily adjusted for exactly +100 V output at the CAL OUT connector.

The network consisting of R1622, R1624 and C1624 prevents any ringing on the rising portion of the square wave.

Output Divider Resistors

Cathode-follower section V1605C has a precision divider network for its cathode resistor. With the CAL AMPL control properly adjusted so the signal amplitude at the cathode of V1605C is exactly 100 V peak to peak, the divider network accurately divides the basic 100 V square wave to lower amplitudes in multiples of 1, 2 or 5 and provides an accurate 50-ohm output resistance when the AMPLITUDE CALIBRATOR switch is set to .2 VOLTS and below. If the 50-ohm output is terminated into a 50-ohm external load, the peak voltage across the external termination will be one-half that indicated by the switch setting.

The 100 V DC is available for use as a reference when the AMPLITUDE CALIBRATOR switch is set to 100 V DC. If the switch is set to the 5 mA position, an accurate 5 mA square wave is fed through the current loop. The accuracy of this current is established by the accurate 20 kΩ series resistance of divider resistors R1632 through R1640.

The 0.25 ohm resistor R1654, connected in series with the output divider resistors R1647 and R1650, minimizes possible ground current effects on the calibrator voltage accuracy; i. e., ground currents that may exist between the oscilloscope chassis and the chassis of some other device that is driven by the Amplitude Calibrator.

NOTES

SECTION 4
MAINTENANCE

Change information, if any, affecting this section is found at the rear of the manual.

Introduction

This section of the manual contains maintenance information for use in preventive maintenance, corrective maintenance, and troubleshooting procedures for the Type 556.

PREVENTIVE MAINTENANCE

General

Preventive maintenance consists of cleaning, visual inspection, lubrication, etc. Preventive maintenance performed on a regular basis will help prevent instrument failure and will improve reliability of this instrument. The severity of the environment to which the Type 556 is subjected will determine the frequency of maintenance required.

We recommend servicing and recalibration after each 500-hour period of operation, or more frequently if the instrument is usually operated under adverse conditions such as a high temperature or a dusty or corrosive atmosphere. Even if the instrument is used only occasionally, it should be serviced and recalibrated at least once every six months.

Exterior Cleaning

Loose dust accumulated on the outside of the Type 556 can be removed with a soft cloth or small paint brush. The paint brush is particularly useful for dislodging dirt on and around the front-panel controls. Dirt which remains can be removed with a soft cloth dampened in a mild solution of water and detergent. Abrasive cleaners should not be used.

Clean the light filter, faceplate protector and CRT face with a soft, lint-free cloth dampened with denatured alcohol.

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Some chemicals to avoid are benzene, toluene, xylene, acetone or similar solvents.

Removal of Panels

The side panels on the Type 556 may be easily removed for access to the internal circuitry . The panels are held in place by slot-head fasteners that can be released with a broad-blade screwdriver or a small coin. Turn each fastener 1/4 turn counterclockwise to free the panel. The top and bottom panels are held in place by Phillips-head screws.

For further acces to the internal circuitry of the Type 556 any of the corner rail angles can be removed by using a Phillips screwdriver.

In addition to providing dust protection and proper shielding, the side, top and bottom panels enable the cooling air to be directed through the filter and fan for proper air circulation throughout the interior of the instrument. The panels should not be removed except during maintenance and calibration.

Interior Cleaning

Dust in the interior of the instrument should be removed occasionally due to its electrical conductivity under high-humidity conditions. The best way to clean the interior is to blow off the accumulated dust with dry, low-velocity air. Remove any dirt which remains with a soft paint brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces or for cleaning ceramic terminal strips and circuit boards.

The high-voltage circuits, particularly parts located in the high-voltage compartment and the area surrounding the post-deflection anode connector, should receive special attention. Excessive dust or dirt in these areas may cause high-voltage arcing and result in improper instrument operation.

Air Filter

The air filter should be visually checked every few weeks and cleaned or replaced if dirty. For cleaning, remove the filter from the rear of the instrument. Wash it in the same manner as a synthetic sponge, rinse and let dry. When the filter is thoroughly dry, coat with fresh air-filter adhesive (available from air conditioner suppliers or order Tektronix Part No. 006-0580-00). Let the adhesive dry thoroughly before re-installing the filter.

If desired, the filter may be replaced by ordering from your local Tektronix Field Office or Representative. The part number is 378-0034-01.

Visual Inspection

The Type 556 should be inspected occasionally for such defects as broken connections, broken or damaged ceramic strips, improperly seated transistors or tubes, damaged circuit boards and heat-damaged parts.

The remedy for most visible defects is obvious; however, care must be taken if heat-damaged parts are located. Overheating is usually only a symptom of trouble. For this reason, it is essential to determine the actual cause of overheating before the heat-damaged part is replaced; otherwise, the damage may be repeated.

Transistor and Tube Checks

Periodic checks of the transistors and tubes in the Type 556 are not recommended. The best check of transistor or tube performance is its actual operation in the instrument. More details on checking transistor and tube operation is given under Troubleshooting.

Lubrication

The reliability of potentiometers, rotary switches and other moving parts can be increased if they are kept properly lubricated. Use a cleaning-type lubricant (such as Tektronix Part No. 006-0218-00) on shaft bushings and switch contacts. Lubricate switch detents with a heavier grease (such as Tektronix Part No. 006-0219-00). Potentiometers should be lubricated with a lubricant which will not affect electrical characteristics (such as Tektronix Part No. 006-0220-00). Do not overlubricate. A lubrication kit containing the necessary lubricants and instructions is available from Tektronix. Order Tektronix Part No. 003-0342-00.

The fan bearings are sealed and do not require lubrication.

CORRECTIVE MAINTENANCE

General

Corrective maintenance consists of component replacement and instrument repair. Special techniques or procedures required to replace components in this instrument are described here.

Obtaining Replacement Parts

Standard Parts. All electrical and mechanical part replacements for the Type 556 can be obtained through your local Tektronix Field Office or representative. However, many of the standard electronic components can be obtained locally in less time than is required to order them from Tektronix, Inc. Before purchasing or ordering replacement parts, consult the Parts List for value, tolerance and rating.

NOTE

When selecting replacement parts, it is important to remember that the physical size and shape of a component may affect its performance at high frequencies. All replacement parts should be direct replacements unless it is known that a different component will not adversely affect instrument performance.

Special Parts. In addition to the standard electronic components, some special parts are used in the Type 556. These parts are manufactured or selected by Tektronix, Inc. to meet specific performance requirements, or are manufactured for Tektronix, Inc. in accordance with our specifications. These special parts are indicated in the Parts List by an asterisk preceding the part number. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. Order all special parts directly from your Tektronix Field Office or representative.

Ordering Parts. When ordering replacement parts from Tektronix, include the following information:

1. Instrument Type.
2. A description of the part (if electrical, include circuit number).
3. Tektronix Part Number.
4. Instrument Serial Number.

Soldering Techniques

WARNING

Disconnect the instrument from the power source before soldering.

To solder or unsolder any small or short-lead component:

1. Use needle-nosed pliers to act as a heat sink between the soldering point and the component;
2. Use a moderately hot iron for a short period of time;
3. Manipulate your tools with care to avoid damage to small components;
4. Use only enough solder to make a good bond.

Due to the presence of normal stray fields and capacitance within the instrument, the locations of some components in the Type 556 are important to the operation of the system. Be sure to install replacement components in the exact positions occupied by the original parts.

After soldering any connection, clip off the excess length of the soldered leads. Be sure that these ends are not dropped into the instrument where they could cause electrical shorting.

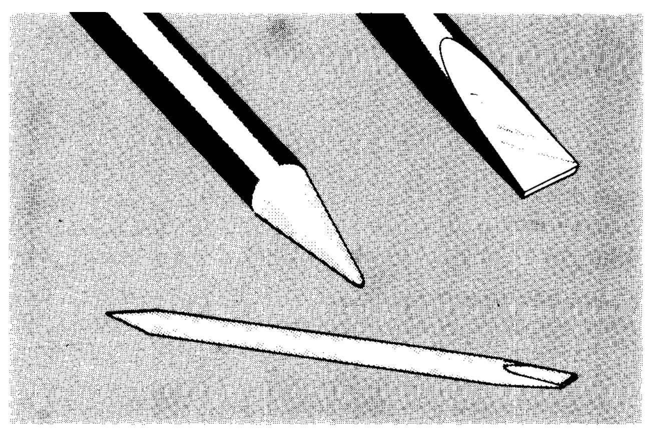


Fig. 4-1. Soldering aid for use with bare wires.

Fig. 4-1 illustrates a handy tool for holding bare wires in place while soldering. It can be made from a short length of wooden dowel or thermoset plastic, with one end shaped as a wedge.

When soldering to a wafer-type switch, do not let the solder flow around and beyond the rivet on the switch terminal. The spring tension of the switch contact may be destroyed by excess solder and the switch will need to be replaced.

Circuit Boards. Use ordinary 60/40 solder and a 35- to 40- watt pencil type soldering iron on the circuit boards. The tip of the iron should be clean and properly tinned for best heat transfer to the solder joint. A higher wattage soldering iron may separate the etched wiring from the base material.

The following technique should be used to replace a component on a circuit board.

1. Grip the component lead with long-nose pliers. Touch the soldering iron to the lead at the solder connection. Do not lay the iron directly on the board, as it may damage the board.

2. When the solder begins to melt, pull the lead out gently. This should leave a clean hole in the board. If not, the hole can be cleaned by reheating the solder and placing a sharp object such as a toothpick or pointed tool into the hole to clean it out.

3. Bend the leads of the new component to fit the holes in the board. If the component is replaced while the board is mounted in the instrument, cut the leads so they will just protrude through the board. Insert the leads into the board until the component is firmly seated against the board. If it does not seat properly, heat the solder and gently press the component into place.

4. Apply the iron and a small amount of solder to the connection to make a firm solder joint. To protect heat-sensitive components, hold the lead between the component body and the solder joint with a pair of long-nose pliers or other heat sink.

5. Clip the excess lead that protrudes through the board.

6. Clean the area around the soldered connection with a flux-remover solvent to maintain good environmental characteristics. Be careful not to remove information printed on the board.

Ceramic Terminal Strips. Solder used on the ceramic terminal strips should contain about 3% silver. Ordinary tin-lead solder can be used occasionally without damage to the ceramic terminal strips. Use a 40- to 75-watt soldering iron with a 1/8 inch wide chisel-shaped tip. If ordinary solder is used repeatedly or if excessive heat is applied, the solder-to-ceramic bond may be broken.

A small roll of 3% silver solder is mounted near the Lower Beam high-voltage compartment on the right side of the instrument. Additional silver solder should be available locally or it can be purchased directly from Tektronix; order by Tektronix Part No. 251-0514-00.

Observe the following precautions when soldering ceramic terminal strips:

1. Use a hot iron for a short time. Apply only enough heat to make the solder flow freely.

2. Maintain a clean, properly tinned tip.

3. Avoid putting pressure on the ceramic terminal strip.

4. Do not attempt to fill the terminal-strip notch with solder; use only enough solder to cover the wires adequately.

5. Clean the flux from the terminal strip with a flux-remover solvent to maintain good environmental characteristics.

Metal Terminals. When soldering metal terminals (for example, switch terminals, potentiometers, etc.), ordinary 60/40 solder may be used. The soldering iron should have a 40- to 75-watt rating with a 1/8 inch wide chisel-shaped tip.

Observe the following precautions when soldering metal terminals:

1. Apply only enough heat to make the solder flow freely.

2. Apply only enough solder to form a solid connection. Excess solder may impair the function of the part.

3. If a wire extends beyond the solder joint, clip off the excess.

4. Clean the flux from the solder joint with a flux-remover solvent to maintain good environmental characteristics.

Ceramic Strip Replacement

To replace a damaged ceramic terminal strip, first unsolder all connections, then pry the mounting studs attached to the strip out of the chassis. If prying is not satisfactory, remove the studs by tapping on the ends protruding from the reverse side of the chassis. Still another way to remove a ceramic strip is to use diagonal cutters and cut off one side of each stud. The remainder of the studs can then be pulled out after the strip has been removed.

If the nylon spacers do not come out with the studs, they may be left in the chassis or pulled out separately. The spacers, if not damaged, can be used with the new ceramic strip assembly. Replacement strips are supplied with mounting studs attached, so it is not necessary to salvage the old studs.

When the damaged strip and stud assembly have been removed, place the spacers into the mounting holes in the chassis and press the mounting studs of the new strip assembly into the spacers. It may be necessary to tap lightly or apply some pressure to the ceramic strip to make the studs seat all the way down into the spacers. To avoid damage to the terminal strip use a soft-tipped tool for tapping, and apply force only to the portion of the strip directly above the mounting studs. Fig. 4-2 shows the assembled terminal strip. Cut off the excess length of the mounting studs extending beyond the ends of the spacers. Resolder all components and wires in place as they were previously arranged (note the soldering techniques described earlier).

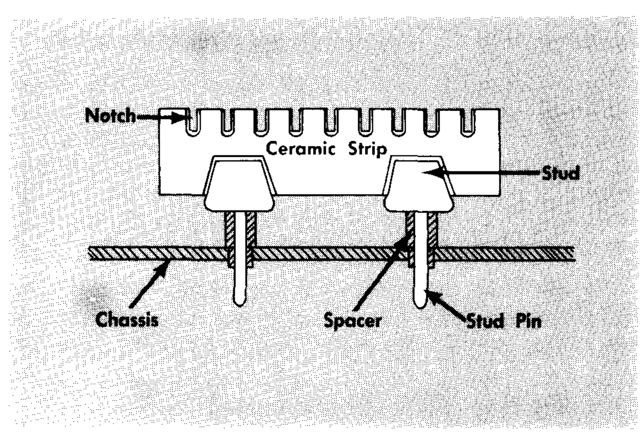


Fig. 4-2. The assembled ceramic strip.

Component Replacement

Transistor and Tube Replacement. Transistors and tubes should not be replaced unless actually defective. If they are removed during routine maintenance, return them to their original sockets. Unnecessary replacement of transistors or tubes may affect the calibration of this instrument. When transistors or tubes are replaced, check the operation of that part of the circuit which may be affected.

Fuse Replacement. Table 4-1 shows the ratings of the fuses used in this instrument. Refer to Figs. 4-3 and 4-4 for the locations.

TABLE 4-1

Fuse Replacement

Fuse Circuit No.	Circuit	Rating
F1401	115 VAC	10 A Slo-Blo
F1402	230 VAC	5 A Slo-Blo
F1424	+350 VDC	0.75 A Fast
F1446	+225 VDC	1.5 A Fast
F1478	+100 VDC	1 A Fast
F1482	—150 VDC	0.75 A Fast

Rotary Switch Replacement. Individual wafers or mechanical parts of rotary switches normally are not replaced. If a switch is defective, replace the entire assembly. Replacement switches can be ordered either wired or unwired; refer to the Parts List for the applicable part numbers.

Circuit Board Assembly Replacement

If a circuit board is damaged and cannot be repaired, a circuit board without components may be obtained; or, if desired, a unit completely wired with components mounted may be obtained by the normal ordering procedure.

All electrical connections to the folowing circuit boards are made with push-on pin conectors: A Sweep Trigger Switch, B Sweep Trigger Switch, A Sweep Trigger, B Sweep Trigger and Power. The push-on connectors to these boards are easily removed. Once the wires are disconnected, removal is a matter of removing the mounting screws and lifting out the board. To reinstall or replace these boards, use the illustrations (see Fig. 4-11 through 4-16 in this section as a guide for reconnecting the wires to the board.

The A Triggering switch circuit board (consisting of five individual lever switches wired to the circuit board) may be removed as an assembly, and the switch to be replaced may be soldered to the board, using the soldering techniques suggested previously. The same procedure is used for the replacement or removal of the B Triggering switch circuit board assembly.

All electrical connections to the High Voltage Delay board* are soldered. Two 40- to 75-watt soldering irons are required to remove this board from the ceramic strip slots.

Cathode-Ray Tube Replacement

Use the following procedure to replace the CRT:

Removal (See Fig. 4-5)

1. At the rear of the instrument, remove the four cap nuts securing the air filter housing. Remove the housing and air filter.

2. Remove the four screws securing the fan assembly. The fan assembly is hinged to allow easy access to the interior of the instrument.

3. Disconnect the CRT socket.

4. Disconnect the lead clips from the deflection pin connectors on the neck of the CRT. The leads to the Lower Beam may be reached through the fan assembly opening.

CAUTION

Be careful to avoid bending the deflection pin connectors.

5. Disconnect the high voltage anode lead.

NOTE

The two wires through the shield near the high voltage anode connector are the leads to the beam rotator coil and should not be removed.

6. At the front of the instrument, remove the four nuts securing the graticule cover. Remove the graticule cover, the light filter (if used), and the clear plastic face plate protector.

7. Remove the plastic ring which holds the light guide to the perimeter of the face plate, and remove the light guide.

8. Loosen the CRT clamp until the CRT can be slid forward and removed.

Replacement

1. Insert the CRT from the front of the instrument with the high voltage anode connector about 90° counterclockwise from a directly upward position.

2. Replace the leads going to the Lower Beam deflection pin connectors one at a time starting with the red (on white) lead and rotating the CRT clockwise as the other leads are replaced. The color code on the CRT shield indicates the correct connections for the deflection pin connectors.

3. Temporarily replace the face plate protector and graticule cover and screw down the knurled retaining nuts.

4. Position the CRT so that the face plate is touching the face plate protector and the vertical graticule lines are parallel to the sides of the instrument.

5. Tighten the CRT neck clamp to 4 inch-pounds (±2 inch-pounds) of torque.

CAUTION

Do not exceed 4 inch-pounds of torque under any condition when tightening the CRT neck clamp.

6. Replace the CRT socket and the remaining deflection pin connectors.

7. Connect the high voltage anode connector.

8. Remove the graticule cover and the face plate protector, and install the light guide and plastic hold-down ring.

***Added in Type 556 S/N 218 and up. Some instruments were modified out of sequence.**

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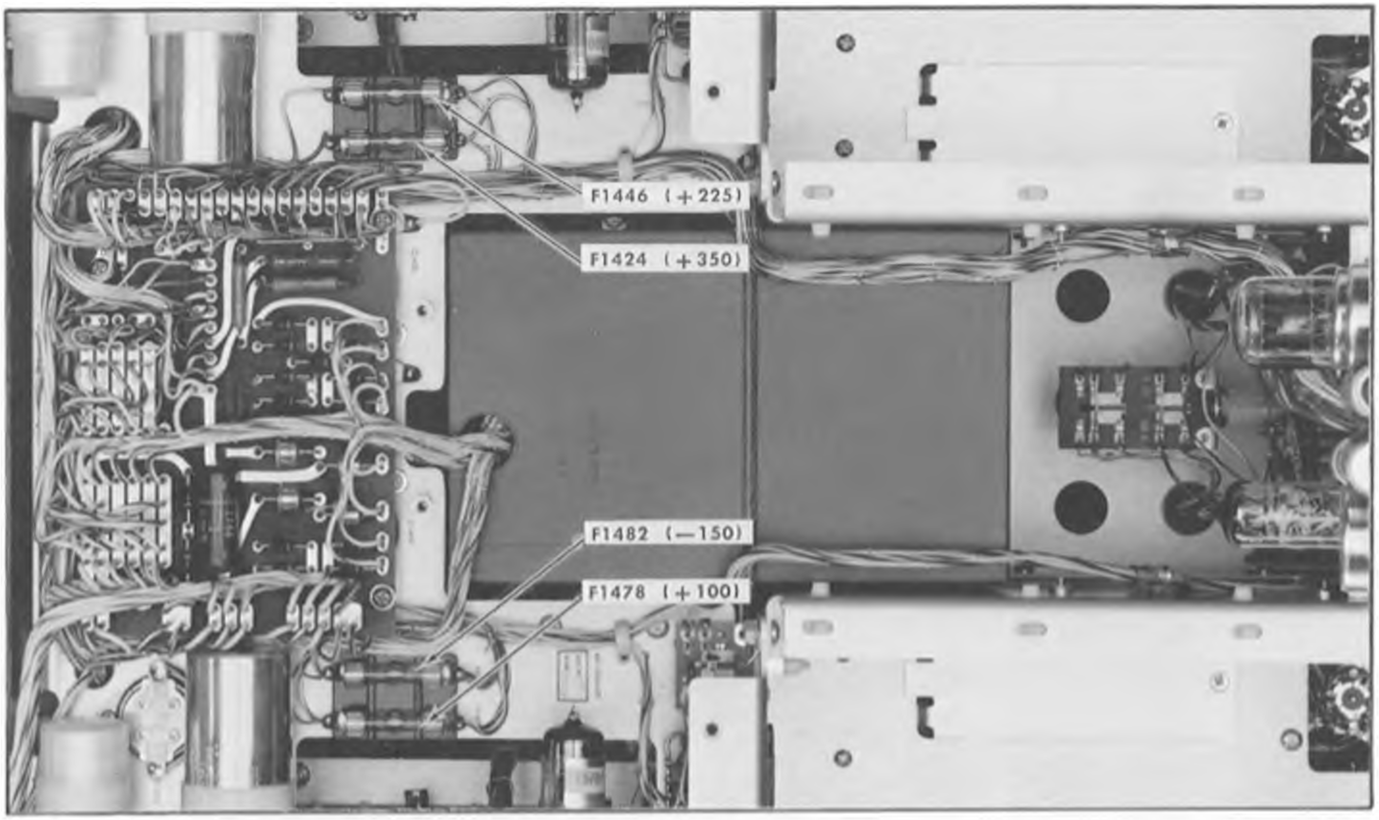


Fig. 4-3. Power Supply fuse locations, bottom view.

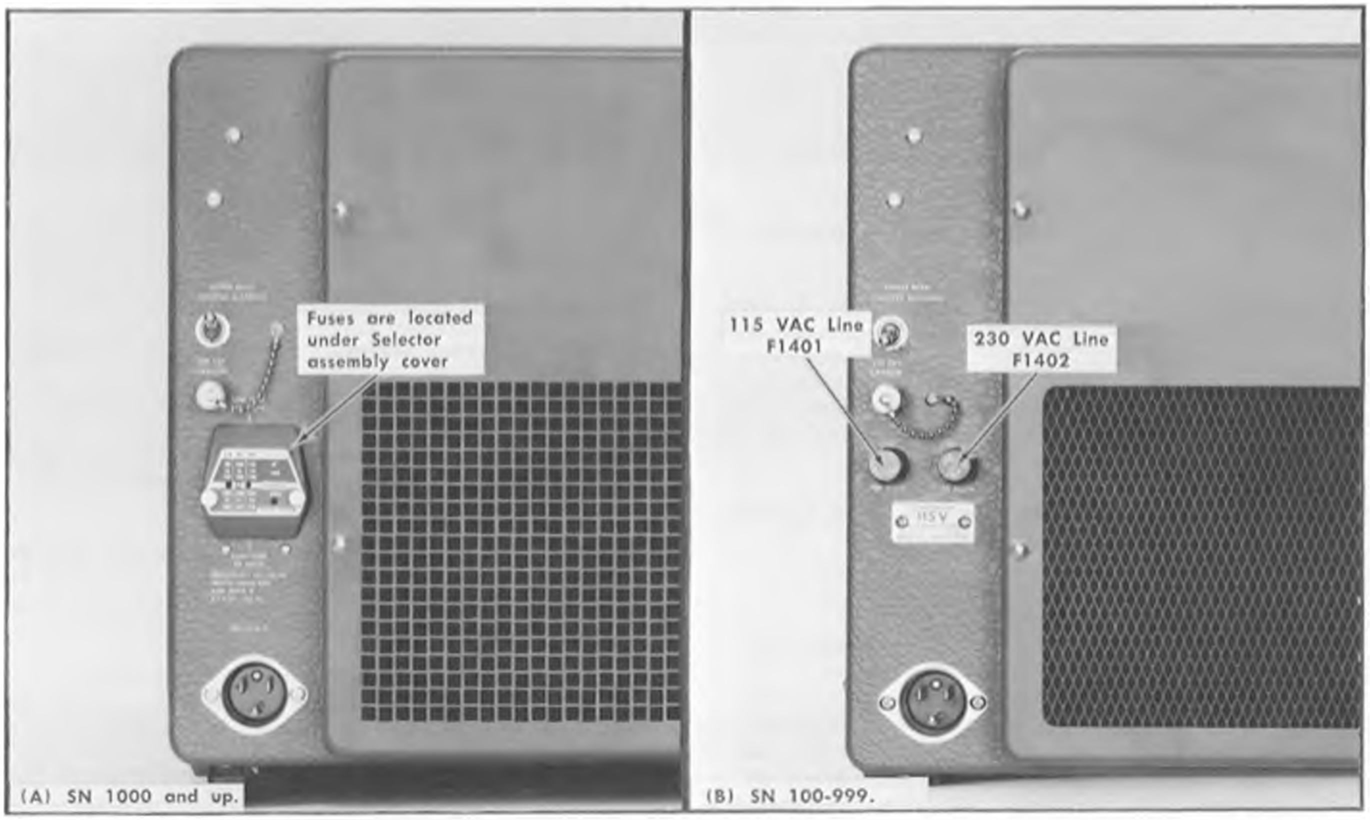


Fig. 4-4. Location of line fuses.

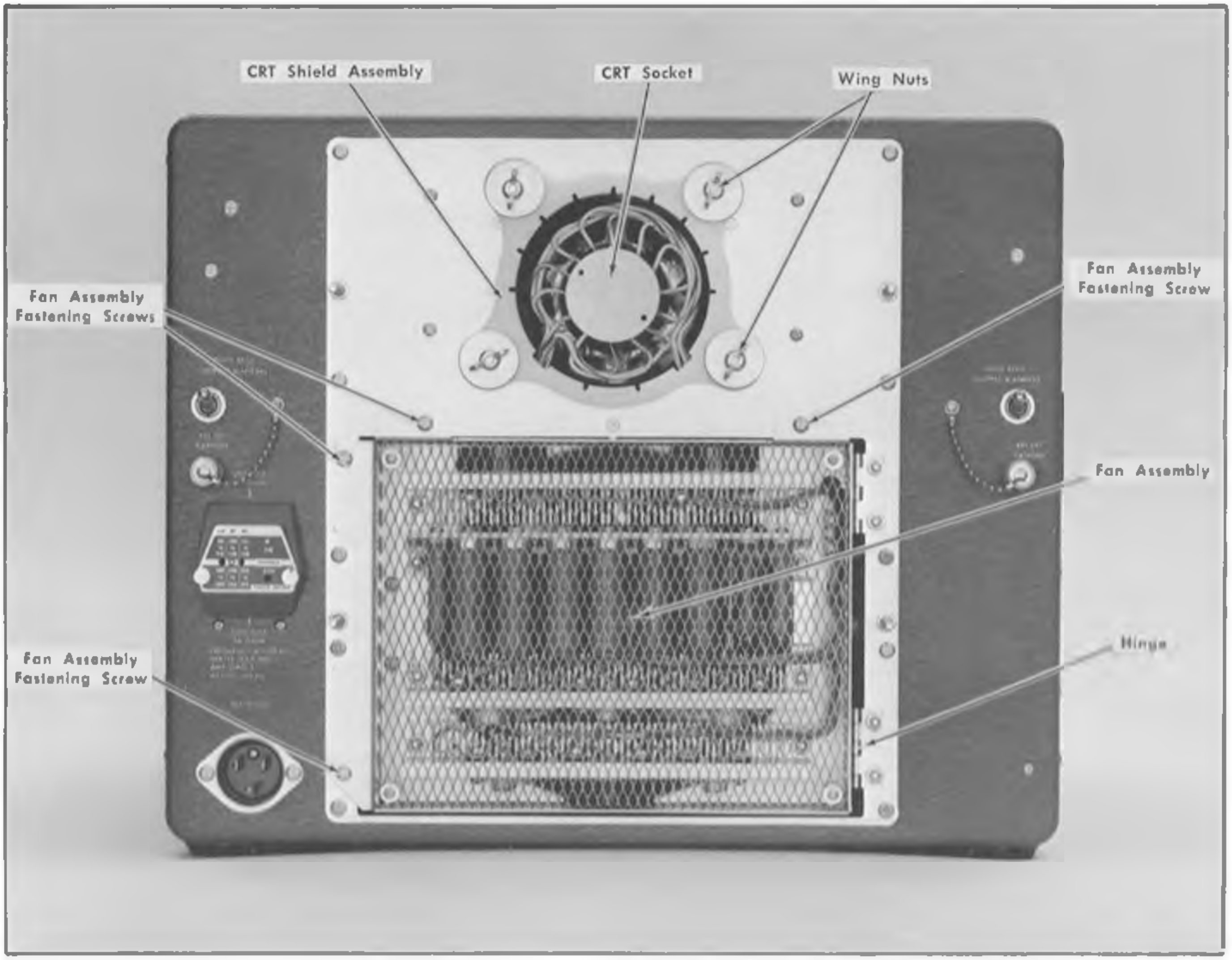


Fig. 4-5 Instrument rear view, CRT replacement (filter housing removed).

9. Replace the faceplate protector, light filter (if used), and the graticule cover, screwing down the graticule nuts.

10. The four wing nuts securing the CRT shield assembly to the back panel may be loosened to permit adjustment of the shield so the CRT faceplate will be exactly parallel with the front panel of the instrument.

11. Adjust the BEAM ROTATION control before beginning the recalibration procedure.

NOTE

After the replacement of any electrical component, it will be necessary to check the calibration of the circuit involved. If other circuits are closely related, as indicated on the schematic diagrams and in Table 4-5, their calibration should also be checked. Since the low voltage supplies affect all circuits, the entire instrument will need recalibration if work has been done on the power supplies or if a power transformer has been replaced.

Power Transformer Replacement

Use the following procedure to replace the low voltage power transformer:

WARNING

Remove the power source plug from the rear of the instrument before attempting to replace the transformer.

1. Disconnect all transformer-lead pin connectors from the power circuit board, including the white wire going from the hinged power-chassis to terminal A (ground) on the power circuit board.

2. Loosen the two knurled fastening screws sufficiently to allow the hinged power chassis to swing away from the instrument.

3. To clear the way for sliding out the transformer (see Step 8) loosen the power supply cables by forcing them out of the two plastic clamps and removing the screws in two other plastic clamps (see Fig. 4-6).

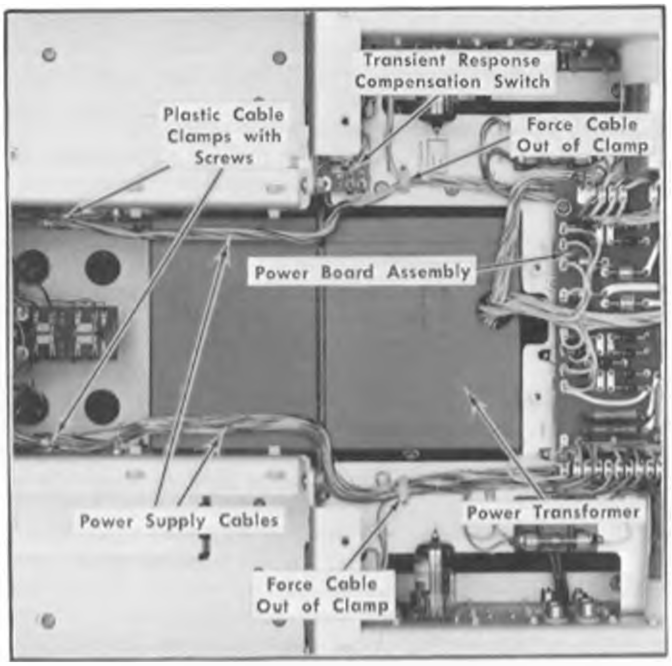


Fig. 4-6. Power transformer replacement (photo taken with hinged power chassis swung open).

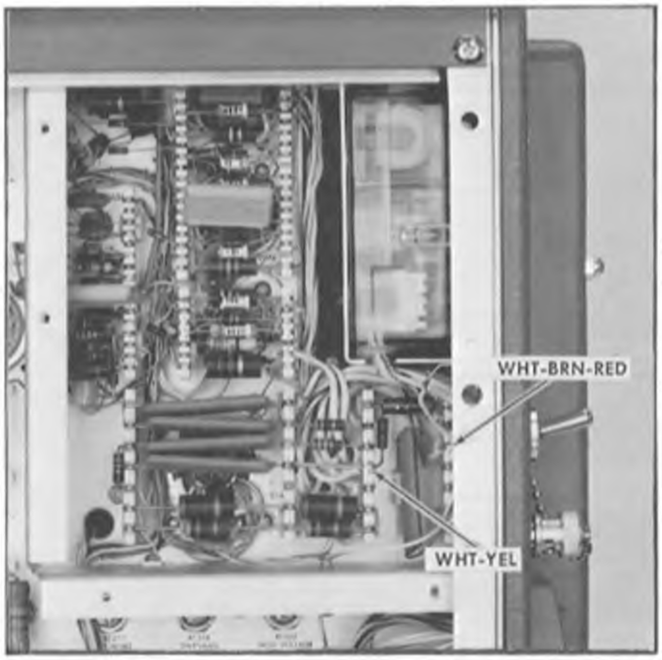


Fig. 4-7. CRT filament lead locations (Lower Beam).

4. Remove both vertical plug-ins from the instrument.

5. Remove the two screws holding the right plug-in transient response compensation switch (Fig. 4-6). The switch can now be dropped slightly to clear the power transformer mounting brackets.

6. Remove 4 power transformer mounting bracket screws (2 in each plug-in compartment).

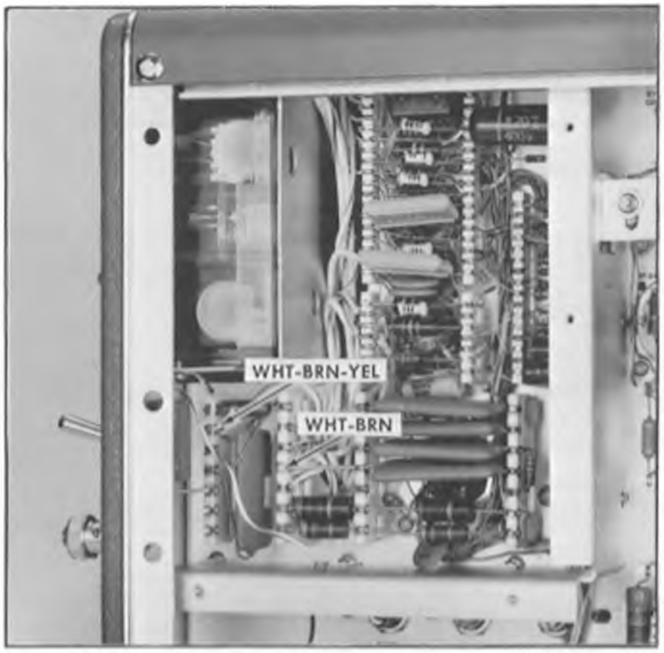


Fig 4-8. CRT filament lead locations (Upper Beam).

7. Unsolder 2 wires from each high voltage compartment, as shown in Fig. 4-7 for the Lower Beam, and Fig. 4-8 for the Upper Beam. These wires are the filament leads to the CRT and are color coded as shown on Fig. 4-7 and 4-8.

8. The transformer can now be slid out of the instrument, using the slack created by loosening the cables (as described in step 3).

CAUTION

The CRT and Power Transformer are isolated by a special metal having unique shielding properties. Also, other painted shields inside the instrument are made of this special metal. Deforming these shields by cutting, bending, or subjecting them to severe mechanical shocks will destroy the magnetic shielding properties of the metal.

9. The new transformer may be installed by reversing the procedures. Refer to the color coding information shown in Figs. 4-7, 4-8 and 4-15.

TROUBLESHOOTING

Introduction

The following information is provided to facilitate troubleshooting of the Type 556. Information contained in other sections of this manual should be used in conjunction with the following information to aid in locating the defective component.

Troubleshooting Aids

Diagrams. Circuit diagrams are shown on foldout pages in Section 9. The circuit number and electrical value of each component in this instrument are indicated on the diagrams. Important voltages and waveforms are also shown.

Component Numbering. Each main circuit in the instrument is assigned a series of circuit numbers. Table 4-2 lists the main circuits in the Type 556 and the series of circuit numbers assigned to each. For example, a resistor numbered R930 is identified as a component in the Delay Pickoff circuit.

TABLE 4-2

Circuit Numbered Location

Circuit No.	Diagram
1-189	Left Vertical Amplifier
200-479	Right Vertical Amplifier
500-565	'A' Sweep Trigger
566-695	'A' Sweep Generator & Timing Switch
700-765	'B' Sweep Trigger
766-895	'B' Sweep Generator & Timing Switch
900-945	Delay Pickoff
1000-1079	Alternate Trace Logic and Blanking
1100-1199	Upper Beam Horizontal Amplifier
1200-1299	Lower Beam Horizontal Amplifier
1300-1399	Cathode-Ray Tube Circuit
1400-1519	Power Supply
1525-1545	Heater Wiring
1550-1599	Plug-in Jack Details
1600-1659	Calibrator

Switch Wafer Identification. Switch wafers shown on the diagrams are coded to indicate the position of the wafer in the complete switch assembly. The numbered portion of the code refers to the wafer number counting from the front, or mounting end of the switch, toward the rear. The letters 'F' and 'R' indicate whether the front or the rear of the wafer performs the particular switching function. For example, a wafer designated 2R indicates that the rear of the second wafer is used for this particular switching function.

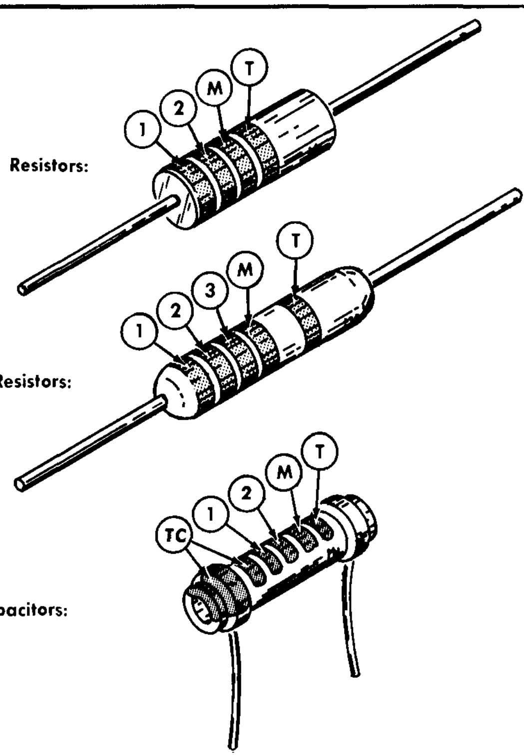
Circuit Boards. Figs. 4-11 through 4-16 show the individual boards, with the circuit numbers for each component identified for each board. The circuit board sections of the diagrams are outlined in blue, to aid in locating components.

Wiring Color Code. All insulated wire used in the Type 556 is color-coded according to the EIA standard color code (as used for resistors) to facilitate circuit tracing. The widest color stripe identifies the first color of the code. Power supply voltages can be identified by three color stripes and the following background color code: white, positive voltage; tan, negative voltage. Table 4-3 shows this wiring color code (with exceptions) for the power supplies in the Type 556. The remainder of the wiring in the Type 556 is color coded, vary-

Composition Resistors:

Metal-Film Resistors:

Ceramic Capacitors:



1 2 and 3 —1st, 2nd and 3rd significant figures;

M —multiplier; T —tolerance;

TC —temperature coefficient.

Resistor and Capacitor Color Code

Color	Significant Figures	Multiplier: Resistors	Multiplier: Capacitors	Tolerance: Resistors	Tolerance: Capacitors
Silver	---	10^{-2}	---	$\pm 10\%$	---
Gold	---	10^{-1}	---	$\pm 5\%$	---
Black	0	1	1	---	$\pm 20\%$ or 2 pF*
Brown	1	10	10	$\pm 1\%$	$\pm 1\%$ or 0.1 pF*
Red	2	10^2	10^2	$\pm 2\%$	$\pm 2\%$
Orange	3	10^3	10^3	$\pm 3\%$	$\pm 3\%$
Yellow	4	10^4	10^4	$\pm 4\%$	$+100\%$ -0%
Green	5	10^5	10^5	$\pm 0.5\%$	$\pm 5\%$ or 0.5 pF*
Blue	6	10^6	10^6	---	---
Violet	7	---	---	---	---
Gray	8	---	10^{-2}	---	$+80\%$ -20% or 0.25 pF*
White	9	---	10^{-1}	---	$\pm 10\%$ or 1 pF*
(none)	---	---	---	$\pm 20\%$	$\pm 10\%$ or 1 pF*

***For capacitance of 10 pF or less.**

NOTE: T and/or TC color code for capacitors depends upon manufacturer and capacitor type. May not be present in some cases.

Fig. 4-9. Color coding of metal-film resistors.

ing from a solid color and no stripes, to a solid color and one or more stripes, as an aid in point-to-point circuit tracing.

TABLE 4-3

Power Supply Wiring

Supply	Back-ground Color	1st Stripe	2nd Stripe	3rd Stripe
—150 V	Tan	Brown	Green	Brown
+6 V[1]	White	Blue		
+10 V[1]	White	Brown		
+100 V	White	Brown	Black	Brown
+225 V	White	Red	Red	Brown
+350 V	White	Orange	Green	Brown

[1]**Exception: Color code partially conforms to EIA standard.**

Resistor Color Code. A number of precision metal-film resistors are used in this instrument. These resistors can usually be identified by their gray body color. If a metal-film resistor has a value indicated by three significant figures and a multiplier, it will be color coded according to the EIA standard resistor color code. If it has a value indicated by four significant figures and a multiplier, the value will be printed on the body of the resistor. For example, a 333 kΩ resistor will be color coded, but a 333.5 kΩ resistor will have its value printed on the resistor body. The color code sequence is shown in Fig. 4-9.

Composition resistors are color coded according to the EIA standard resistor color code.

Troubleshooting Techniques

This troubleshooting procedure is arranged in an order which checks the simple trouble possibilities before proceeding with extensive troubleshooting. The first few checks assure proper connection, operation and calibration. If the trouble is not located by these checks, the remaining steps aid in locating the defective component. When the defective component is located, it should be replaced following the replacement procedures given in this section.

NOTE

Check all fuses. Often a blown fuse cannot be detected by visual means. The ratings and locations of fuses are shown in Table 4-1 and Figs. 4-3 and 4-4.

1. Check Associated Equipment. Before proceeding with troubleshooting of the Type 556, check that the equipment used with the Type 556 is operating correctly. Check that the signal is properly connected and that the interconnecting cables or probes are not defective. Also, check the power source.

2. Check Control Settings. Incorrect control settings can indicate a trouble that does not exist. For example, incorrect setting of the A or B TIME/CM VARIABLE controls appears as an uncalibrated sweep; incorrect setting of the Triggering controls appears as a defective sweep or trigger circuit; incorrect setting of the Variable Volts/cm controls appears as incorrect gain, etc. If there is any question about the correct function or operation of any control, see the Operating Instructions section of this manual.

Incorrect operation of all circuits often indicates trouble in the Low Voltage Power Supply. Check first for correct adjustment of the individual supplies. However, a defective component elsewhere in the instrument can appear as a power supply trouble and may affect the operation of other circuits.

Table 4-4 lists the tolerances of the power supplies in the Type 556. If a power supply voltage is within the listed tolerance, the supply can be assumed to be working correctly. If outside the tolerance, the supply may be misadjusted or operating incorrectly. Use the procedure given in the Calibration section to adjust the power supplies.

TABLE 4-4

Power Supply Tolerances

Voltage	Tolerance
—150 V	±1.5 V
+100 V	±1.0 V
+225 V	±0.625 V[2]
+350 V	±10.5 V

[2]**Measured between +100 and +225 V.**

3. Check Instrument Calibration. Check the calibration of the instrument, or the affected circuit if the trouble exists in one circuit. The indicated trouble may only be a result of misadjustment or may be corrected by calibration. Complete instructions are given in the Calibration section of this manual. Individual calibration steps can be performed out of sequence. However, if the circuit affects the calibration of other circuits in the instrument, a more complete calibration will be necessary. General Information in the Calibration section describes how calibration steps which interact are noted.

4. Isolate trouble to a particular circuit. The Type 556 incorporates a significant feature in its design that greatly simplifies the isolation of a trouble to a particular circuit. This feature is the built-in versatility of the instrument which incorporates two independent vertical and horizontal deflection systems (with the exception of the low voltage and CRT circuits). The vertical input circuits are mounted in plug-in units that can be quickly replaced or extended to facilitate isolation and troubleshooting. In addition, the time base circuits can be switched by front panel controls so the Upper Beam can be operated by either the A or B time base generator, and the Lower Beam by the B Time Base generator.

An example using the front-panel controls is as follows: Supposing the A Sweep Generator is suspect because the sweep will not trigger. Since the A Sweep Trigger is connected to the A Sweep Generator, the A Sweep Trigger circuit could also be at fault. To substitute these circuits, set the Upper Beam DISPLAY switch to LEFT PLUG-IN B and the B Triggering SOURCE switch to LEFT INT NORM. Now the B Sweep Trigger and B Sweep Generator can be used to check whether an Upper Beam display can be obtained.

Another example using the front-panel controls is as follows (but this time a coaxial patch cord is also used): Suppose the Lower Beam Horizontal Amplifier is suspect. In this case the Lower Beam DISPLAY switch can be set to RIGHT PLUG-IN

TABLE 4-5

Circuit Interconnections

	Pwr. Sup.	Htr. Wrg.	L Vert. Amp.	R Vert. Amp.	A Swp. Trig.	A Swp. Gen.	B Swp. Trig.	B Swp. Gen.	Dly. P. O.	Alt. Trace Logic & Blkg.	Upr. Beam Horiz. Amp.	Lwr. Beam Horiz. Amp.	CRT Circuit		Calib.
													Upr. Beam	Lwr. Beam	
Power Supply	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Heater Wiring	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Left Vertical Amplifier	X	X	X	X	X								X		
Right Vertical Amplifier	X	X	X	X			X							X	
A Sweep Trigger	X	X	X		X	X									
A Sweep Generator	X	X			X	X			X	X	X				
B Sweep Trigger	X	X		X			X	X							
B Sweep Generator	X	X					X	X	X	X		X			
Delay Pickoff	X	X				X		X	X						
Alternate Trace Logic and Blanking	X	X				X		X		X					
Upper Beam Horizontal Amplifier	X	X				X					X		X		
Lower Beam Horizontal Amplifier	X	X						X				X		X	
CRT Circuit — Upper Beam	X	X	X								X		X	X	
CRT Circuit — Lower Beam	X	X		X								X	X	X	
Calibrator	X	X													X

EXT and a patch cord can be connected from the A SAWTOOTH connector through an attenuator to the LOWER BEAM EXT HORIZONTAL IN connector. Now the A sweep can be used to drive the Lower Beam Horizontal Amplifier to check whether a normal trace can be obtained.

Thus the system can usually be used to check for the isolation of a trouble to a particular circuit. If one beam is operating properly, it can be used to signal-trace the defective circuit.

The Type 556 can be used to signal-trace all of its own circuits except:

1. Lower Beam CRT Circuit.
2. Alternate-Trace Logic Circuit (Q1004, Q1015, and Q1025).
3. Power Supply Circuit.

The signal-tracing is done in the following manner:

The Upper Beam side of the oscilloscope is used to signal-trace all of the Lower Beam circuits except the Lower Beam CRT circuit. The Upper Beam can also be used to check ripple in the Low Voltage Power Supply (when the supplies are regulating) and to signal-trace the Calibrator circuit.

The Lower Beam side of the oscilloscope can be used to signal-trace all of the Upper Beam circuits and the Delay Pickoff circuit.

For checking the Lower Beam CRT and Alternate-Trace Logic circuits, a test oscilloscope is required. The test oscilloscope should have a frequency response of DC to 10 MHz or higher and a minimum deflection factor of 0.05 V/cm when using a 10× probe. To show time relationship in the Alternate-Trace Logic Circuit, the test oscilloscope should be externally triggered by the A GATE signal from the Type 556.

The Type 556 contains 15 main circuits. The normal interconnections between these circuits is given in Table 4-5 to aid in circuit isolation. Since the table lists only the main circuits, all interconnections may not be indicated.

To isolate a trouble to a circuit, note the trouble symptom. The symptom often identifies the circuit in which the trouble is located. For example, poor focus of both beams indicates that the CRT circuit (includes high voltage) is probably at fault. When trouble symptoms appear in more than one circuit, or if the trouble is not located in the circuit which indicates the trouble, Table 4-5 may aid in locating the cause of the trouble. To use the table, find the vertical line which shows the circuit(s) affected. Check the first circuit listed in the left column. If this circuit is not the source of the trouble, check the next circuit listed in the left column which interacts, etc. Methods of checking the defective circuits after they have been located are given in steps 5 through 8.

The pin connectors used to connect the circuit boards to the instrument provide a convenient means of circuit isolation. For example, a short in a power supply can be isolated to the Low-Voltage Power Supply by disconnecting pin connectors for that voltage at the boards.

After the defective circuit has been located, proceed with steps 5 through 8 to locate the defective component(s). If the trouble has not been isolated to a circuit using the procedure described here, check the voltages and waveforms as explained in step 7 to locate the defective circuit.

5. Check Circuit Board connections. If the trouble is isolated to a circuit board that has push-on connectors, check the connectors on the circuit board for correct connection. Figs. 4-11 through 4-16 shows the correct connections for each of these boards.

6. Visual Check. Visually check the circuit in which the trouble has been located. Many troubles can be located by visual indications such as broken wires, damaged circuit boards or damaged components.

7. Check Voltages and Waveforms. Often the defective components can be located by checking for the correct voltage or waveform in the circuit. Typical voltages and waveforms are given on the Schematic Diagrams.

NOTE

Voltages and waveforms given on the diagrams may vary slightly between instruments. To obtain operating conditions similar to those used to take readings, see the IMPORTANT note on the foldout portion to the left of the Vertical Block Diagram. In addition, refer to the diagram for the circuit being checked.

CAUTION

When troubleshooting the circuits, be sure the probe tip or test prods can be used in tight places without causing an accidental short circuit. If care is not used, a short circuit can cause damage to several semiconductors; particularly in the vertical amplifiers.

The waveforms on the schematic diagrams are shown in three configurations, depending on whether the Upper Beam section, the Lower Beam section, or a separate test oscilloscope is used to obtain the particular waveform. The Type 556 graticule is shown with its eight vertical divisions, whereas the separate test oscilloscope is shown with six vertical divisions. The waveforms obtained with the Upper Beam display are shown in the upper part of the eight-division graticule and the Lower Beam displays are located in the lower portion of the graticule. The displays obtained by using the separate test oscilloscope are generally near the center of the six vertical divisions graticule. See the illustrations, Fig. 4-10.

Voltage measurements should be taken with a 20,000 ohm/volt DC meter. Accuracy of the voltmeter should be within 3% on all ranges. The test prods should be well insulated to avoid shorting of components adjacent to the test point.

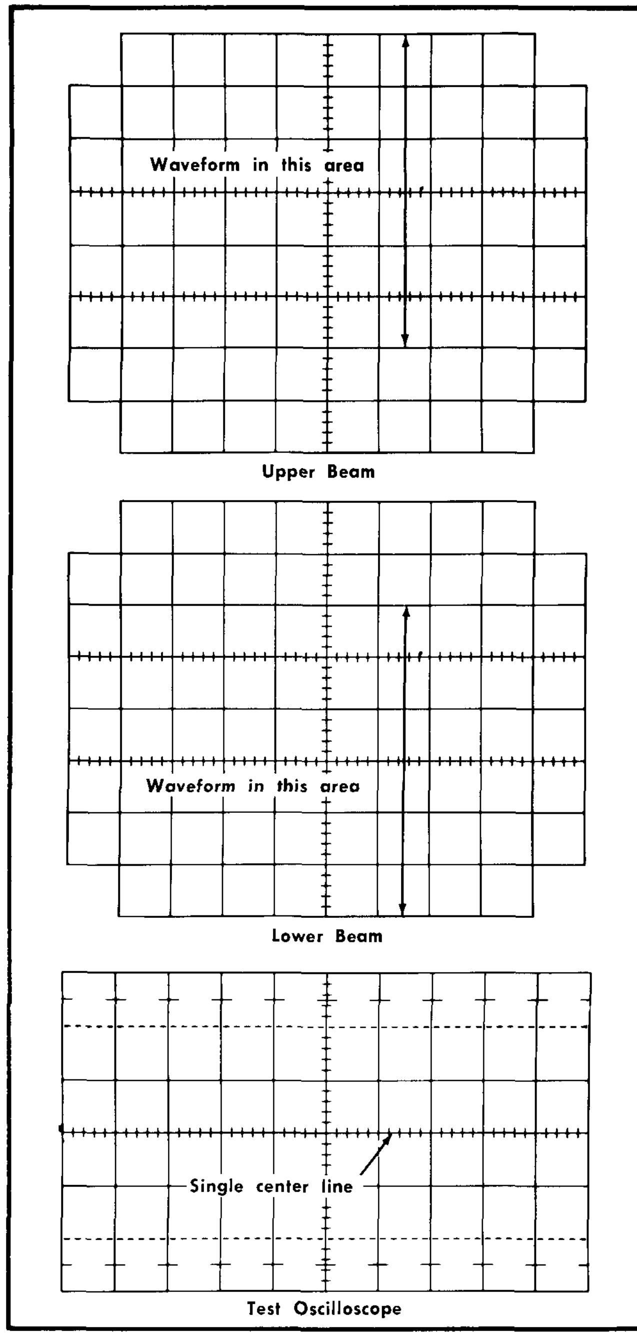


Fig. 4-10. Waveform source identification.

8. Check Individual Components. The following procedures describe methods for checking individual components in the Type 556. Components which are soldered in place can be checked more easily by disconnecting one end. This eliminates incorrect measurements due to the effects of surrounding circuitry.

Transistors and Tubes. *The best check of transistor or* tube operation is a performance check under actual operating conditions. If a transistor or tube is suspected of being defective, it can best be checked by substituting a new component or one which has been checked previously. However, be sure that circuit conditions are not such that the replacement transistor or tube might also be damaged. If substitute transistors or tubes are not available, a dynamic tester may be used (such as Tektronix Type 570 or 575). Static type testers are not recommended, however, since they do not check operation under simulated operating conditions.

NOTE

Two small access plates have been provided inside each plug in compartment to allow easy inspection or replacement of the A and B Sweep Generator tubes V625 and V825.

CAUTION

Care should be exercised when replacing plastic-cased transistors, as two types of lead configurations are manufactured. If in doubt as to the correct lead nomenclature, refer to the manufacturer's basing diagrams. Some transistors have the lead code (E,B,C) marked on the case. All transistor sockets in this instrument are wired for the lead configuration used in metal-cased transistors.

Diodes. A diode (excluding the tunnel diodes, zener diodes and the silicon diodes in the CRT circuit) usually can be checked for an open or shorted condition by measuring the resistance between terminals. With an ohmmeter scale having an internal source of about 1.5 volts, the resistance should be very high in one direction and very low when the leads are reversed.

CAUTION

Do not use an ohmmeter scale that has a high internal current. High currents may damage the diode. Do not measure tunnel diodes with an ohmmeter; use a dynamic tester (such as Tektronix Type 575 Transistor-Curve Tracer).

Resistors. Resistors can be checked with an ohmmeter. Check the Electrical Parts List for the tolerance of the resistors used in this instrument. Resistors normally do not need to be replaced unless the measured value varies widely from the specified value.

Inductors. Check for open inductors by checking continuity with an ohmmeter. Shorted or partially shorted inductors can usually be found by checking the waveform response when high-frequency signals are passed through the circuit. Partial shorting often reduces high-frequency response (roll-off).

Capacitors. A leaky or shorted capacitor can best be detected by checking resistance with an ohmmeter on the highest scale. Do not exceed the voltage rating of the capacitor. The resistance reading should be high after initial charge of the capacitor. An open capacitor can best be detected with a capacitance meter or by checking whether the capacitor passes AC signals.

NOTES

NOTES

SECTION 5
PERFORMANCE CHECK

Change information, if any, affecting this section is found at the rear of the manual.

Introduction

This section of the manual provides a means of rapidly checking the performance of the Type 556. It is intended to check the calibration of the instrument without the need for performing the complete Calibration Procedure. The Performance Check does not provide for the adjustment of any internal controls. Failure to meet the requirements given in this procedure indicates the need for internal checks or adjustments, and the user should refer to the Calibration Procedure in this manual.

Recommended Equipment

The following equipment is recommended for a complete performance check. Specifications given are the minimum necessary to perform this procedure. All equipment is assumed to be calibrated and operating within the original specifications. If equipment is substituted, it must meet or exceed the specifications of the recommended equipment.

For the most accurate and convenient performance check, special calibration fixtures are used in this procedure. These calibration fixtures are available from Tektronix, Inc. Order by part number through your local Tektronix Field Office or representative.

1. Test oscilloscope. Bandwidth, DC to 10 MHz; minimum deflection factor, 0.005 volts/division; 1× and 10× probes. Tektronix Type 531A Oscilloscope recommended, with Type W plug-in.

2. 10× probe with BNC connector. Tektronix Type P6006 recommended. Part No. 010-0128-00.

3. 1× probe with BNC connector. Tektronix Type P6028 recommended. Part No. 010-0120-00.

4. Time-mark generator. Marker outputs, 5 seconds to 0.1 microsecond; sine-wave output at 50 MHz. Tektronix Type 184 recommended.

5. Constant-amplitude sine-wave generator. Frequencies, 50 kHz and 350 kHz up to ≥50 MHz; output amplitude, at least 1 volt; amplitude accuracy, ±5% into 50 Ω load. Tektronix Type 191 recommended.

6. Test load and pulser unit. Tektronix Calibration Fixture, Part No. 067-0521-00 (2 required).

7. Amplitude calibrator. Amplitude accuracy, within 0.25%; signal amplitude, 0.1 volt to 100 volts; output signal, 1 kHz square-wave and +DC; must have mixed display feature. Tektronix Calibration Fixture 067-0502-00 recommended.

8. Variable autotransformer. Must be capable of supplying 1 kVA over a voltage range of 90 to 130 VAC (182 to 260 volts for 230-volt nominal line). If autotransformer does not have an AC voltmeter (RMS), monitor the output with a voltmeter having a range of at least 130 volts (or 260 volts). For example, General Radio W10MT3W Metered Variac Autotransformer.

9. Plug-in preamplifiers with dual-channel inputs, vertical deflection sensitivity to 5 millivolts/cm. Tektronix Type 1A1 or equivalent, 2 required. Include one 18-inch 50 Ω cable (Tektronix Part No. 012-0076-00).

10. Low-frequency sine-wave signal generator, 30 Hz to 60 kHz, 1 volt output, Heathkit Model 1G-72 or equivalent.

11. Current probe. Sensitivity, 1 milliamp/division; accuracy within 3%. Tektronix P6019 Current Probe with Type 134 Amplifier recommended.

12. 3-wire power socket assembly (required only if autotransformer is equipped with a single output power socket). Tektronix Part No. 136-0102-00.

13. 3-wire power cable 20 inches long (required only if autotransformer is equipped with a single output power socket). Tektronix Part No. 161-0014-00.

14. Precision 50-ohm termination. For example, Tektronix Calibration Fixture Part No. 067-0515-00.

15. 50-ohm terminations; accuracy, 3%; BNC connectors. Tektronix Part No. 011-0049-00; two required.

16. BNC T connector. Tektronix Part No. 103-0030-00.

17. Adapter. Connectors, GR to BNC jack. Tektronix Part No. 017-0063-00.

18. Cable. Impedance, 50 ohm; type, RG58A/U; length, 42 inch; connectors, BNC. Tektronix Part No. 012-0057-00. Four required.

19. Patch cord, 18 inch with BNC plug-jack terminals on each end. Tektronix Part No. 012-0087-00.

PERFORMANCE CHECK PROCEDURE

General

In the following procedure, test equipment connections or control settings should not be changed except as noted. If only a partial check is desired, refer to the preceding step(s) for setup information.

The following procedure uses the equipment listed under "Recommended Equipment". If substitute equipment is used, control settings or setup must be altered to meet the requirements of the equipment used.

Preliminary Procedure

1. Install the test load units in the oscilloscope plug-in compartments.

2. Connect the Type 556 to the autotransformer and connect the autotransformer to a line voltage within the regulating range of the oscilloscope power supplies.

3. Set the Type 556 Upper and Lower Beam INTENSITY controls fully counterclockwise.

4. Set the Type 556 POWER switch to ON and set the autotransformer for 115 VAC (or 230 VAC).

5. Allow 20 minutes for instrument warmup. Meanwhile, set the remaining controls as follows:

A Triggering Controls	
SOURCE	NORM INT LEFT
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Clockwise, pushed in
Upper Beam Controls	
DISPLAY	LEFT PLUG-IN A
POSITION	Mid-range
DISPLAY MAG	×1
FOCUS	Adjust for best display
ASTIGMATISM	Adjust for best display
CONTRAST	Clockwise
UPPER BEAM EXT HORIZ VAR 10-1	Clockwise
A Sweep Controls	
A TIME/CM	0.5 mSEC
VARIABLE	CALIBRATED
A MODE	NORM
B Triggering Controls	
SOURCE	NORM INT RIGHT
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Clockwise, pushed in
Lower Beam Controls	
DISPLAY	RIGHT PLUG-IN B
POSITION	Mid-range
DISPLAY MAG	×1
FOCUS	Adjust for best display
ASTIGMATISM	Adjust for best display
CONTRAST	Clockwise
LOWER BEAM EXT HORIZ VAR 10-1	Clockwise
B Sweep Controls	
B TIME/CM	0.5 mSEC
VARIABLE	CALIBRATED
B MODE	NORM
SCALE ILLUMINATION	Adjusted to illuminate graticule lines
TRACE SEPARATION	Mid-range
DELAY-TIME MULTIPLIER	1.00
AMPLITUDE CALIBRATOR	OFF
Rear Panel Controls	
Upper Beam CRT Cathode Selector	EXT CRT CATHODE
Lower Beam CRT Cathode Selector	EXT CRT CATHODE
Test Load Units (both)	
Test Function	Low Load
Variable	mid-range
Amplitude	mid-range
Vertical Position	mid-range
Repetition Rate	Low

1. Check Amplitude Calibrator Operation

a. Requirement—Voltage accuracy, ±2%; terminated voltage accuracy, one-half of indicated voltage ±2%; repetition rate, 1 kHz ±25%; duty cycle, 45 to 55%; risetime, 1.5 microseconds or less.

b. Set the AMPLITUDE CALIBRATOR to 100 VDC, and connect a 50 Ω cable from the CAL OUT connector to the Standard Amplitude Calibrator Unknown Input connector.

c. Set the test oscilloscope time/cm switch to 50 microsecond.

d. Set the Type W plug-in unit as follows:

Input Atten	100
Channel A Ac-Dc-Gnd	Dc
Channel B Ac-Dc-Gnd	Gnd
Millivolts/cm	10
Display	A-Vc
Vc Range	+1.1
Comparison Voltage (Vc)	10.00

NOTE

Familiarity with the operation of the Type W plug-in unit is a prerequisite to the use of this procedure.

e. Set the Standard Amplitude Calibrator to 100 Volts +DC Mixed, and connect a 50-ohm cable from the Output connector to the Type W Channel A input connector.

f. Adjust the test oscilloscope for a free-running display. With correct adjustment of the Type W, the display will be on or near the reference level established by the Comparison Voltage.

g. Check—Separation of the display traces (see Fig. 5-1) not more than 2 cm (±2%). A single trace indicates that the AMPLITUDE CALIBRATOR voltage and the Standard Amplitude Calibrator voltage are equal.

h. Set instrument controls as indicated in Table 5-1, checking for tolerances as shown.

i. Change the AMPLITUDE CALIBRATOR to .2 VOLTS, and the Standard Amplitude Calibrator to .1 Volts.

j. Insert the precision termination (listed under Recommended Equipment, item 14) between the Type 556 CAL OUT connector and the 50-ohm cable, using adapters as necessary.

TABLE 5-1

Calibrator Amplitude Accuracy Check

AMPLITUDE CALIBRATOR	Standard Amplitude Calibrator	Type W control settings: Input Atten	Millivolts/cm	Vc Range	Comparison Voltage (Vc)	Tol.
100 V DC	100 Volts +DC	100	10	+1.1	10.000	2 cm
100 VOLTS	100 Volts (square wave)	100	10	+1.1	10.000	2 cm
50	50	100	5	+1.1	5.000	2 cm
20	20	100	2	+1.1	2.000	2 cm
10	10	10	10	+1.1	10.000	2 cm
5	5	10	5	+1.1	5.000	2 cm
2	2	10	2	+1.1	2.000	2 cm
1	1	1	10	+1.1	10.000	2 cm
.5	.5	1	5	+1.1	5.000	2 cm
.2	.2	1	2	+1.1	2.000	2 cm
.1	.1	1	1	+1.1	1.000	2 cm
50 mVOLTS	50 mV	1	1	+1.1	0.500	1 cm

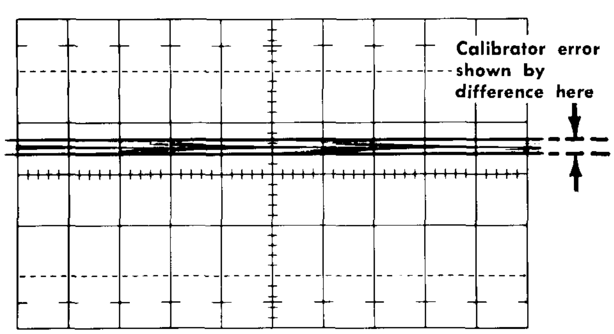


Fig. 5-1. Amplitude Calibrator accuracy check.

k. Change the Type W Comparison Voltage (Vc) dial to 1.000.

l. Check—Separation of display traces not more than 2 cm.

m. Remove the Standard Amplitude Calibrator signal, and remove the precision termination.

n. Change the Type W Vc Range switch to 0.

o. Connect an 18-inch 50-ohm cable (furnished with the Type 1A1, see item 9) from the CAL OUT connector to the Type W Channel A input connector, set the Input Atten switch to 100, and the Millivolts/cm to 5.

p. Set the AMPLITUDE CALIBRATOR switch to 2 VOLTS.

q. Set the test oscilloscope time/cm to 0.2 milliseconds, and obtain a stable display.

r. Check—1 cycle of the displayed waveform between 3.75 cm and 6.25 cm in length.

s. With the vertical deflection factor of the plug-in unit at 0.5 volts/cm, obtain a stable display at a sweep rate of 0.1 milliseconds/cm.

t. With the test oscilloscope positioning control, move the display so that the rising portion of the display coincides with the 1-cm vertical graticule line.

u. Change the display length with the time/cm variable control, so that one cycle of the display is 8 cm long.

v. Check—Falling portion of the waveform not more than 4 mm either side of the graticule center vertical line (duty cycle 45 to 55%).

w. Return the variable time/cm control to the calibrated position.

x. Change the AMPLITUDE CALIBRATOR to 5 VOLTS.

y. Adjust the display amplitude to 5 cm with the Variable Millivolts/cm control.

z. Set the test oscilloscope time/cm to 0.2 microseconds, and adjust the triggering level control to display the full rising portion of the waveform.

aa. Adjust the horizontal and vertical Position controls simultaneously so that the 10% point of the rising portion of the waveform crosses an intersection of a vertical and a horizontal graticule line (see Fig. 5-2).

ab. Measure the horizontal distance between the 10% and 90% points on the rising portion of the waveform.

ac. Check—Risetime 1.5 microseconds or less.

ad. Change the test oscilloscope vertical deflection factor to 10 volts/cm.

ae. Change the AMPLITUDE CALIBRATOR to 100 VOLTS.

af. Adjust the display as in steps (z) and (aa), with an amplitude of 5 cm.

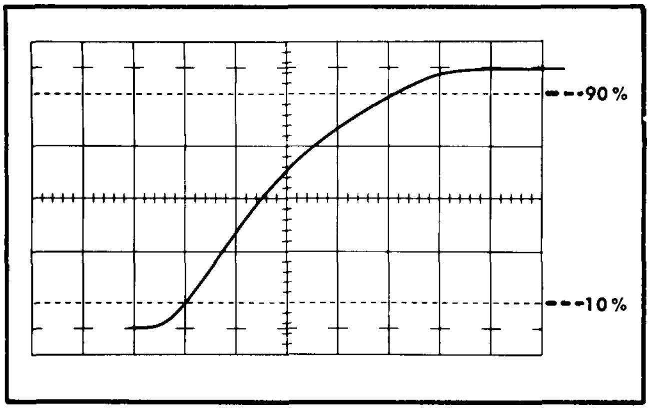


Fig. 5-2. Typical display, amplitude calibrator risetime. Indicated risetime is 0.8 microseconds.

ag. Check—Risetime 1.5 microseconds or less.

ah. Remove the 50-ohm cable.

2. Check 5 mA Current Loop

a. Requirement—5 mA current indication in current loop.

b. Connect the Type 134 Amplifier and P6019 Current-measuring Probe to the vertical input of the test oscilloscope.

c. Set the Type 134 Amplifier attenuator to 2 mA/div.

d. Change the test oscilloscope vertical deflection Volts/cm switch to 50 millivolts/cm.

e. Clip the probe to the current loop on the front panel of the Type 556.

f. Rotate the AMPLITUDE CALIBRATOR switch through all positions, noting that no waveform is displayed at any position except the 5 mA setting.

g. Check—Display amplitude of approximately 2.5 cm at the 5 mA switch position.

h. Remove the Type 134 Amplifier and Current-measuring Probe.

3. Check Trace Rotation

a. Requirement—Traces can be adjusted parallel to the horizontal graticule lines.

b. Position the Upper and Lower Beam traces to their respective graticule center horizontal lines with the traces starting at the 0-cm graticule lines.

c. With a small screwdriver, adjust the TRACE ROTATION control.

d. Check—Traces can be adjusted parallel to the horizontal graticule lines.

4. Check Beam Finder Operation

a. Requirement—Overscanned display returns to the display area when the BEAM FINDER button is depressed.

b. Depress the BEAM FINDER button and hold in this position.

c. Rotate first the right and left vertical position controls fully clockwise and counterclockwise, and then the Upper Beam and Lower Beam POSITION controls, while observing the position of both displays.

d. Check—Both displays should remain within the graticule viewing areas while the BEAM FINDER button is depressed.

5. Check Geometry

a. Requirement—Alignment of markers with the vertical graticule lines within 1 mm.

b. Remove both Test Load units, and in their places install Type 1A1 plug-in units.

c. Apply 1-millisecond markers from the time-mark generator (item 4 of Recommended Equipment) through a BNC T connector, two 50 Ω cables and 50 Ω terminations to the Type 1A1 vertical inputs of both plug-ins.

d. Check that the A and B TIME/CM switches are set to .5 mSEC.

e. Adjust both plug-in variable volts/cm controls so that the displays over-scan both Upper and Lower Beam respective graticule areas.

f. Pull the A and B LEVEL control knobs outward and adjust the A and B Triggering controls for stable displays on both beams.

g. Adjust both plug-in vertical position controls so that the time-mark base line is below the viewing areas for the two beams.

h. Adjust the Upper and Lower Beam POSITION controls so that the first time marks for both beams are superimposed at the left-hand (0-cm) vertical graticule line.

i. Adjust the A and B TIME/CM VARIABLE controls for one time mark per cm on both displays. Time marks will now be superimposed over the entire graticule area.

j. Check—Maximum deviation of the traces from vertical graticule lines should not exceed 1 mm. See Fig. 5-3 for examples of geometry adjustment.

k. Disconnect the marker signals and position the Lower Beam trace to the bottom graticule line. Check for vertical trace deviation (bowing or tilt) of not more than 1 mm.

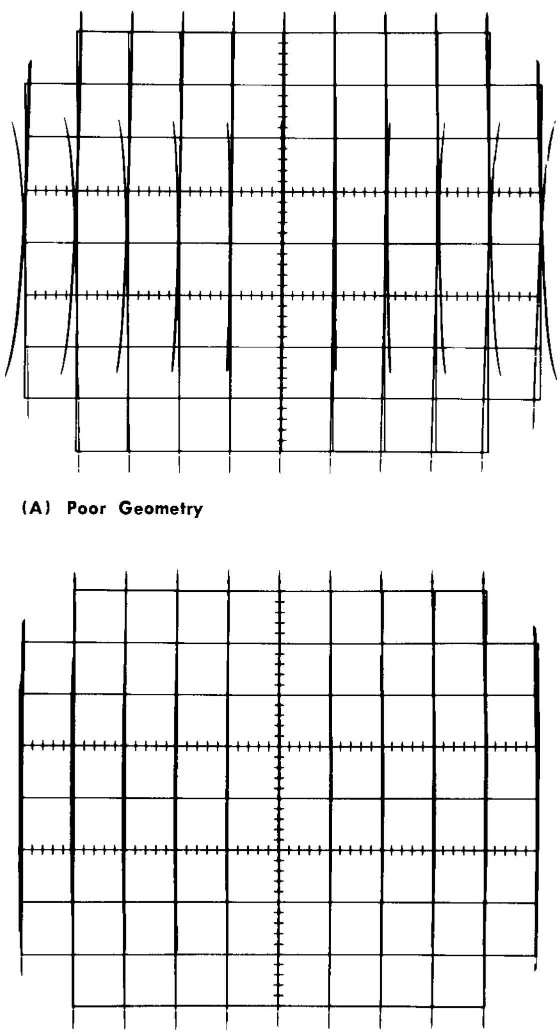
l. Position the Upper Beam trace to the top graticule line and check for vertical trace deviation (bowing or tilt) of not more than 1 mm.

m. Set the A and B TIME/CM VARIABLE controls to CALIBRATED.

6. Check Focus and Astigmatism Control Operation

a. Requirement—Sharp, well-defined display.

b. Apply 100-microsecond markers to both plug-in unit vertical inputs.



(A) Poor Geometry

(B) Good Geometry

Fig. 5-3. Typical CRT displays showing (A) poor geometry adjustment; (B) good geometry adjustment.

c. Adjust both plug-in unit vertical position controls so that the time-mark base lines are below the viewing areas for the beams.

d. Check—Well-defined markers with optimum settings of the FOCUS and ASTIGMATISM controls. (When making the check, the INTENSITY controls can be set so one display at a time is viewed.)

7. Check Upper and Lower Beam Scan Areas

a. Requirement—6 × 10 cm scan area for each beam.

b. Change both A and B TIME/CM switches to .1 mSEC.

c. Set the time-mark generator for 1-microsecond markers.

d. Turn the Upper Beam INTENSITY control so that the Upper Beam display is no longer visible.

e. Adjust the right plug-in vertical deflection factor so that the raster produced by the markers over-scans the Lower Beam graticule area.

f. Check—The scan area equals or exceeds 6 × 10 cm.

g. Extinguish the Lower Beam display with the INTENSITY control and turn the Upper Beam INTENSITY control to produce a display on the Upper Beam.

h. Check—The Upper Beam scan area equals or exceeds 6 × 10 cm.

8. Check CRT Orthogonality

a. Requirement—Angle between horizontal and vertical traces 90 degrees ±1 mm.

b. Set the A TIME/CM switch to 1 mSEC.

c. Set the time-mark generator for 1-millisecond and 0.1-millisecond markers.

d. Adjust the A Triggering controls for a stable display.

e. Position an Upper Beam 1-millisecond marker at the intersection of a vertical graticule line and the horizontal graticule line 3 cm below the Upper Beam graticule center horizontal line.

f. Check—The adjacent 0.1 millisecond marker should not cross the Upper Beam graticule center vertical line at the point 3 cm above the Upper Beam graticule center horizontal line.

g. Repeat steps (b) through (f) for the Lower Beam.

h. Disconnect the time markers.

9. Check Vertical Amplifier DC Balance—Right and Left

a. Requirement—Traces within 1 cm of graticule center line with common-mode input.

b. Replace the Type 1A1 plug-ins with two test load units. Allow at least three minutes for the Type 556 to stabilize.

c. Set the test load unit Test Function switches to Common Mode.

d. Check—Upper and Lower Beams traces within 1 cm of the respective center lines of the Upper and Lower Beam graticule areas.

10. Check Trace Separation Range

a. Requirement—The TRACE SEPARATION control should have sufficient range to superimpose the Upper Beam trace on the Lower Beam trace within the center 4-cm area of the graticule.

b. Change the Upper Beam DISPLAY switch to RIGHT PLUG-IN A.

c. Change the right plug-in unit Test Function to Low Load.

d. Using the right plug-in unit Vertical Position control, position the Lower Beam trace to coincide with the horizontal graticule line located 1-cm below the Lower Beam graticule center horizontal line.

e. Using the TRACE SEPARATION control, position the Upper Beam trace so it is superimposed on the Lower Beam trace.

f. Check—The TRACE SEPARATION control should have sufficient range to superimpose the Upper Beam trace on the Lower Beam trace within the center 4-cm area of the graticule.

11. Check Vertical Amplifier Gain

a. Requirement—Vertical deflection accuracy ±3%.

b. Set the controls as follows:

A Triggering Controls	
SOURCE	LEFT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Clockwise, knob pulled outward
Upper Beam DISPLAY	LEFT PLUG-IN A
Upper Beam DISPLAY MAG	×1
A TIME/CM	.1 mSEC
A VARIABLE	CALIBRATED
B Triggering Controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Clockwise, knob pulled outward
Lower Beam DISPLAY	RIGHT PLUG-IN B
Lower Beam DISPLAY MAG	×1
B TIME/CM	.1 mSEC
B VARIABLE	CALIBRATED
B MODE	NORM
TRACE SEPARATION	Centered
Test Load Units (both)	
Test Function	Gain Set

c. Set both test load unit Test Function switches to Gain Set.

d. Connect a 50 Ω cable from the Standard Amplitude Calibrator Output connector to the left test load unit Ext Input connector.

e. Check that both A and B TIME/CM switches are set to .1 mSEC.

f. Set the Standard Amplitude Calibrator to supply a 100-V square-wave output.

g. Center the Upper Beam free-running display in the Upper Beam viewing area.

h. Change the B Triggering MODE switch to TRIG. The Lower Beam will no longer be visible.

i. Check—Display amplitude of 4 cm ±1.2 mm.

j. Remove the calibrator signal from the left plug-in unit and instead, connect the signal to the right plug-in test load Ext Input connector.

k. Change the B Triggering MODE switch to AUTO STABILITY and the A Triggering MODE switch to TRIG. The Lower Beam display will now be the only one visible.

l. Center the Lower Beam free-running display in the Lower Beam viewing area.

m. Check—Display amplitude of 4 cm ±1.2 mm.

n. Return the A Triggering MODE switch to AUTO STABILITY, and change the Upper Beam DISPLAY switch to RIGHT PLUG-IN A. Both beam displays will again be visible.

o. Decrease the Lower Beam INTENSITY control (counterclockwise rotation) until the Lower Beam display is no longer visible.

p. Use the TRACE SEPARATION control to center the Upper Beam free-running display in the Upper Beam viewing area.

q. Check—Display amplitude of 4 cm ±1.2 mm.

12. Check Vertical Amplifier Compression/Expansion—Left, Right, and Crossover

a. Requirement—No more than 0.5 mm amplitude change in 2 cm signal.

b. Equipment setup remains as in step 11. Change the Standard Amplitude Calibrator to a 50-V square-wave output and apply the signal to the left plug-in unit.

c. Set the Upper Beam DISPLAY switch to LEFT PLUG-IN A and center the 2-cm display in the Upper Beam viewing area. Note the display amplitude.

d. With the left test load unit Vertical Position control, move the 2 cm display to the top 2 cm of the graticule.

e. Check—The change in display amplitude not to exceed ±0.5 mm.

f. Move the Upper Beam display so it is centered in the Lower Beam viewing area.

g. Check—The change in display amplitude not to exceed ±0.5 mm with respect to the amplitude noted in step (c).

h. Change the A Triggering MODE switch from AUTO STABILITY to TRIG. The Upper Beam display will now disappear.

i. Apply the Standard Amplitude Calibrator signal to the right plug-in unit.

j. Increase the Lower Beam INTENSITY control (clockwise rotation) until the Lower Beam display is visible.

k. Center the 2 cm display in the Lower Beam viewing area. Note the display amplitude.

l. With the right test load Vertical Position control, move the 2 cm display so it is centered in the Upper Beam viewing area.

m. Check—The change in display amplitude not to exceed ±0.5 mm.

n. Move the 2 cm display to the bottom 2 cm of the graticule.

o. Check—The change in display amplitude not to exceed ±0.5 mm with respect to the amplitude noted in step (k).

p. Return the A Triggering MODE switch to AUTO STABILITY.

q. Set the Upper Beam DISPLAY switch to RIGHT PLUG-IN A. The Upper and Lower Beam displays will now be visible. Decrease the intensity of the Lower Beam display.

r. Using the right test load Vertical Position control, center the Upper Beam 2 cm display in the Upper Beam viewing area. Note the display amplitude.

s. Move the 2 cm display to the top 2 cm of the graticule. Use the right test load Vertical Position control to move the display.

t. Check—The change in display amplitude not to exceed ±0.5 mm.

u. Use the right test load Vertical Position control to move the display so it is centered in the Lower Beam viewing area.

v. Check—The change in display amplitude not to exceed ±0.5 mm with respect to the amplitude noted in step (r).

13. Check Common Mode Rejection

a. Requirement—Not more than 3 mm vertical deflection with common mode input of 1 volt.

b. Set the Standard Amplitude Calibrator to 1 volt squarewave output.

c. Connect a BNC T connector to the Standard Amplitude Calibrator Output connector. Using 50 Ω cables, apply the signal to both test load Ext Input connectors.

d. Set both the right and left test load unit Test Function switches to Common Mode.

e. Change the Upper Beam DISPLAY switch to LEFT PLUG-IN A and increase the intensity of the Lower Beam trace to normal brightness.

f. Check—The signal amplitude on both beam displays not to exceed 3 mm.

g. Change the Upper Beam DISPLAY switch to RIGHT PLUG-IN A.

h. Check—The signal amplitude on the Upper Beam display not to exceed 3 mm.

i. Remove the Standard Amplitude Calibrator signal from both test load unit inputs.

14. Check Trace Drift with Line Voltage Change

a. Requirement—Vertical drift of the Upper or Lower Beam trace not to exceed 2 mm with change in line voltage.

b. Set the controls as follows:

A Triggering Controls	
SOURCE	LEFT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Clockwise, knob pushed in
Upper Beam DISPLAY	LEFT PLUG-IN A
A TIME/CM	1 mSEC
B Triggering Controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Clockwise, knob pushed in
Lower Beam DISPLAY	RIGHT PLUG-IN B
B TIME/CM	1 mSEC
Test Load Unit (both)	
Test Function	Gain Set
Test Oscilloscope	
Time/cm	5 milliseconds
Type W	
AC-DC-GND (A)	DC
AC-DC-GND (B)	GND
Input Atten	100
Millivolts/cm	50
Display	A-Vc
Vc Range	0
Autotransformer	115 (RMS)

NOTE

The following procedure applies only to a Type 556 connected to a nominal 115-volt 3-wire power source. For an instrument connected to other than a nominal 115-volt source, a procedure and test fixtures adapted to local conditions will be required; for example, a 230-volt source will require an autotransformer with the higher output, an isolation transformer for the test oscilloscope, power sockets, etc.

c. Connect the 20-inch power cord between the autotransformer and the power socket assembly, and connect the Type 556 power cord to the power socket assembly.

NOTE

The short power cord and the socket assembly (items 12 and 13 of Recommended Equipment) are used only to provide convenient measurement terminals with a minimum of hazard. If the autotransformer used is equipped with more than one output socket, the cord and socket assembly may be eliminated.

d. Connect a 1× probe to the test oscilloscope input connector.

e. Connect the probe ground lead to the ground pin of one of the sockets in the power socket assembly.

f. With the probe tip, determine which of the two remaining socket contacts is the neutral contact, and connect the probe tip to this contact.

g. Change the Type W Millivolts/cm switch to 20. The vertical deflection sensitivity should now be 2 volts/cm.

h. Measure the peak voltage of the waveform, as shown in Fig. 5-4.

i. Set the Type W Comparison Voltage (Vc) dial to 178 plus the reading obtained in step (h).

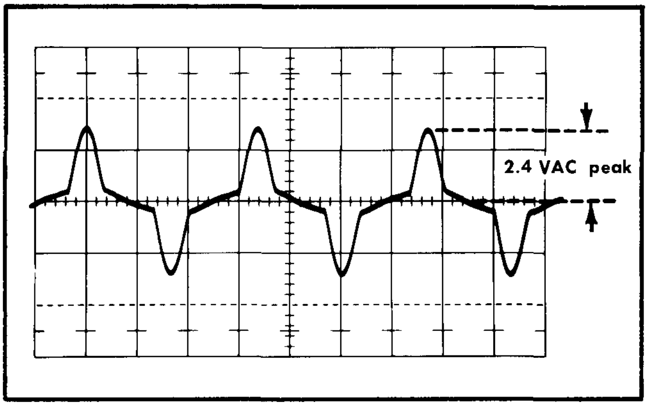


Fig. 5-4. Illustrating measurement of voltage drop in neutral wire. Probe connected between grounding pin and neutral wire; Type W Time/cm, 5 milliseconds; vertical sensitivity, 2 volts/cm.

Example: If the reading obtained in step (h) was 2.4 volts, the dial should be set to 180.4.

j. With the right and left plug-in units vertical position controls, adjust the Upper and Lower Beam traces to their respective graticule center horizontal lines.

k. Set the Vc Range to +11.

l. Change the Millivolts/cm switch to 10.

m. Move the probe tip from the neutral contact to the high-voltage or "hot" contact in the power socket assembly.

n. Adjust the autotransformer output until the tips of the waveforms shown on the test oscilloscope reach the reference line established previously by the Type W. (See Fig. 5-5 for typical display). The test oscilloscope is now indicating 178 peak VAC at the autotransformer output, or 126 volts RMS.

o. Wait two minutes to allow the Type 556 to stabilize, and observe the position of the Upper and Lower Beam traces.

p. Check—Vertical drift of either trace should not exceed 2 mm upward or downward.

q. Return the autotransformer output to 115 volts.

r. Allow about 2 minutes at the 115-volt setting of the autotransformer, then recheck that the Upper and Lower Beam traces are on their respective center horizontal graticule lines.

s. Set the Type W Comparison Voltage (Vc) dial to 141.4 plus the reading obtained in step (h).

t. Adjust the autotransformer output until the tips of the waveform shown on the test oscilloscope reach the reference

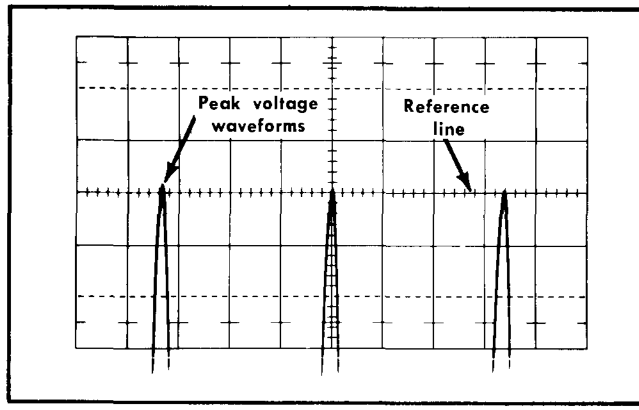


Fig. 5-5. Illustrating method of peak line voltage measurement; Type W plug-in vertical deflection factor 1 V/cm; sweep rate 5 milliseconds/cm.

line established previously by the Type W. The test oscilloscope is now indicating 141.4 peak VAC at the autotransformer output, or 100 volts RMS.

u. Wait two minutes to allow the Type 556 to stabilize, and observe the position of the Upper and Lower Beam traces.

v. Check—Vertical drift of either trace should not exceed 2 mm upward or downward.

w. Return the autotransformer setting to 115 volts, disconnect the probe, and return the Type W Vc Range switch to 0.

15. Check Alternate Trace Operation

a. Requirement—Trace alternation at all sweep rates.

b. Connect the BNC T connector to the Type 556 CAL OUT connector. Connect two 50 Ω cables from the T connector to the Ext Input connectors on the right and left test load units.

c. Set the AMPLITUDE CALIBRATOR to 10 VOLTS, and set the Test Function switches on both Test Load units to Alternate.

d. Check—Two traces on the Upper Beam display, with the calibrator signal appearing on only one trace.

e. Rotate the A TIME/CM switch through all positions from 1 mSEC to .1 μSEC checking for two traces on the Upper Beam display for all positions. Return the A TIME/CM switch to 1 mSEC.

f. Repeat steps (d) and (e) for the Lower Beam, checking for two traces in all positions of the B TIME/CM switch from 1 mSEC through .1 μSEC.

g. Change the Upper Beam DISPLAY switch to LEFT PLUG-IN B.

h. Rotate the B TIME/CM switch through all positions from 1 mSEC to .1 μSEC.

i. Check—Two traces displayed by each beam in all positions of the B TIME/CM switch.

j. Change the Upper Beam DISPLAY switch to RIGHT PLUG-IN A.

k. Rotate the A TIME/CM and B TIME/CM switches through all positions from 1 mSEC to .1 μSEC, keeping the A and B TIME/CM settings the same.

NOTE

With the Upper Beam DISPLAY switch in the RIGHT PLUG-IN A position, a multiple trace will appear on both displays for some of the switch positions. This condition is normal.

l. Check—Two traces on each beam at all positions of the TIME/CM switches.

m. Change the Upper Beam DISPLAY switch to RIGHT PLUG-IN B.

n. Rotate the B TIME/CM switch through all positions from 1 mSEC to .1 μSEC.

o. Check—Two traces displayed by each beam at all settings of the TIME/CM switches from 1 mSEC through .1 μSEC.

p. Remove the AMPLITUDE CALIBRATOR signal from both plug-ins.

16. Check Multi-Trace Chopping Transient Blanking

a. Requirement—Blanking of switching transients.

b. Change both test load unit Test Function switches to Chopped.

c. Set the Upper Beam DISPLAY switch to LEFT PLUG-IN A.

d. Set both TIME/CM switches to 5 μSEC.

e. Adjust the A and B Triggering LEVEL controls for stable displays on both beams.

f. Change the Upper Beam CRT Cathode Selector switch (on rear panel) to UPPER BEAM CHOPPED BLANKING.

g. Check—Disappearance of fast chopping transients (vertical lines) on the Upper Beam display.

h. Change the Lower Beam CRT Cathode Selector switch (on rear panel) to LOWER BEAM CHOPPED BLANKING.

i. Check—Disappearance of fast chopping transients on the Lower Beam display.

j. Repeat steps (f) and (g) with the Upper Beam DISPLAY switch in the LEFT PLUG-IN B, RIGHT PLUG-IN A, and RIGHT PLUG-IN B positions.

NOTE

With the Upper Beam DISPLAY switch in the RIGHT PLUG-IN A position, the A Triggering SOURCE switch should be changed to RIGHT for that one position only.

k. Reset both CRT Cathode Selector switches to EXTERNAL CRT CATHODE.

l. Disconnect the coaxial cables and BNC T connector.

17. Check External Trigger Sensitivity

a. Requirement—Stable displays with 0.2-volt input at 1 kHz.

b. Remove the test load units and in their place install the Type 1A1 plug-in units.

c. Set the controls as follows:

A Triggering Controls	
SOURCE	EXT
COUPLING	AC
SLOPE	+
MODE	TRIG
LEVEL	Centered, knob pushed in
Upper Beam DISPLAY	LEFT PLUG-IN A
Upper Beam DISPLAY MAG	×1
A TIME/CM	1 mSEC
A VARIABLE	CALIBRATED
A MODE	NORM
B Triggering Controls	
SOURCE	EXT
COUPLING	AC
SLOPE	+
MODE	TRIG
LEVEL	Centered, knob pushed in
Lower Beam DISPLAY	RIGHT PLUG-IN B
Lower Beam DISPLAY MAG	×1
B TIME/CM	1 mSEC
B VARIABLE	CALIBRATED
B MODE	NORM

d. Connect a BNC T and two 50 Ω cables from the Standard Amplitude Calibrator output connector to the input connector of the right plug-in unit, and the B Triggering TRIGGER INPUT connector.

e. Set the right plug-in unit vertical deflection switch to 1 volt/cm and the Input Selector switch to DC.

f. Set the Standard Amplitude Calibrator to 0.2 volts, square wave output.

g. Check—Stable display may be obtained with adjustment of the B Triggering LEVEL control.

h. Change the Standard Amplitude Calibrator to 50 millivolts.

i. Check—No stable display may be obtained with adjustment of the LEVEL control.

j. Change the two 50 Ω cables from the right plug-in unit input connector and the B Triggering TRIGGER INPUT connector to the left plug-in unit input connector and the A Triggering TRIGGER INPUT connector.

k. Set the left plug-in unit vertical deflection switch to 1 volt/cm and the Input Selector switch to DC.

l. Set the Standard Amplitude Calibrator to 0.2 volts, square-wave output.

m. Check—A stable display may be obtained with adjustment of the A Triggering LEVEL control.

n. Change the Standard Amplitude Calibrator to 50 millivolts.

o. Check—No stable display may be obtained with adjustment of the LEVEL control.

18. Check Triggering Level Control Ranges

a. Requirement—EXT, at least ±2 volts; ×10, at least ±20 volts.

b. Change the right and left plug-in unit vertical attenuation switches to 5 volts/cm.

c. Set the Standard Amplitude Calibrator to 2 volts, +DC in the mixed mode.

d. Turn the A Triggering LEVEL control fully clockwise.

e. Check—Display not triggered, demonstrating that the control has moved the DC level of the Triggering circuit beyond the positive 2-volt signal amplitude.

f. Change the Standard Amplitude Calibrator to —DC output.

g. Set the A Triggering SLOPE switch to —.

h. Turn the A Triggering LEVEL control fully counterclockwise.

i. Check—Display not triggered, demonstrating that the control has moved the level of the triggered circuit beyond the amplitude of the negative 2-volt input signal.

j. Set the Standard Amplitude Calibrator for 20 volts output.

k. Pull out the A Triggering LEVEL control knob (PULL FOR ×10 RANGE INCREASE).

l. Check—Display not triggered.

m. Change the Standard Amplitude Calibrator to +DC.

n. Set the A Triggering SLOPE switch to +.

o. Turn the A Triggering LEVEL control fully clockwise.

p. Check—Display not triggered.

q. Change the Standard Amplitude Calibrator output from the A Triggering TRIGGER INPUT connector to the B Triggering TRIGGER INPUT connector, and from the left plug-in unit vertical input connector to the right plug-in unit vertical input connector.

r. Pull out the B Triggering LEVEL control knob, and turn the control fully clockwise.

s. Check—Display not triggered.

t. Set the Standard Amplitude Calibrator for —DC output.

u. Set the B Triggering SLOPE switch to —.

v. Turn the B Triggering LEVEL control fully counterclockwise.

w. Check—Display not triggered.

x. Set the Standard Amplitude Calibrator for 2 volts output, and push the LEVEL control knob in.

y. Check—Display not triggered.

z. Change the Calibrator output to +DC.

aa. Change the B Triggering SLOPE switch to +, and turn the LEVEL control fully clockwise.

ab. Check—Display not triggered.

ac. Push in the A Triggering LEVEL control knob and disconnect the Standard Amplitude Calibrator signal.

19. Check Internal Triggering—Lower Beam

a. Requirement—Correct triggering with the following trigger coupling conditions and signal inputs:

AC:	2 mm 60 Hz to 10 MHz, increasing to 1 cm at 50 MHz.
AC LF REJ:	≥3 cm at 30 Hz, 2 mm 2.5 kHz to 10 MHz, increasing to 1 cm at 50 MHz.
AC HF REJ:	2 mm 60 Hz to 60 kHz, increasing to 1 cm at 6 MHz.
DC:	3.5 mm DC to 10 MHz, increasing to 2 cm at 50 MHz.

b. Set the B Triggering SOURCE switch to RIGHT INT NORM the MODE switch to AUTO STABILITY, and the B TIME/CM switch to .2 μSEC.

c. Set the constant-amplitude generator for a 10-MHz signal, apply the signal through a 50 Ω cable and 50 Ω termination to the right plug-in unit, and adjust the plug-in unit vertical controls to display a signal 2 mm in amplitude.

d. Check—Stable displays can be obtained on the Lower Beam with the B Triggering COUPLING switch in the AC and AC LF REJ positions. The LEVEL control may be adjusted as necessary to obtain a stable display.

NOTE

If desired, set the B Triggering MODE switch to TRIG when performing the "check" steps in this procedure (step 19). Use the AUTO STABILITY position between the "check" steps when setting up the display amplitude.

e. Change the generator frequency to 50 MHz.

f. Set the B Triggering COUPLING switch to AC, and the Lower Beam DISPLAY MAG switch to ×10.

g. Adjust the amplitude of the display to 1 cm.

h. Check—Stable displays may be obtained with adjustment of the LEVEL control.

i. Remove the constant amplitude generator signal from the right plug-in connector and connect the output of the low-frequency signal generator through a coaxial cable to the same connector.

j. Set the B Triggering COUPLING switch to AC HF REJ, the B TIME/CM switch to 50 μSEC, and return the Lower Beam DISPLAY MAG switch to ×1.

k. Set the generator frequency to 60 kHz and adjust the display amplitude to 2 mm.

l. Check—Stable display may be obtained with adjustment of the LEVEL control.

m. Replace the low-frequency signal generator with the constant amplitude generator; set the generator frequency to 6 MHz. Set the Type 556 B TIME/CM switch to .5 μSEC, and the display amplitude to 1 cm.

n. Check—No stable display with adjustment of the LEVEL control.

o. Change the B Triggering SOURCE switch to PLUG-IN INT and the COUPLING switch to AC.

p. Set the right plug-in Variable Volts/cm control to Calib and set the generator amplitude control for 4 mm display on the Lower Beam.

q. Check—Stable display may be obtained while adjusting the LEVEL control.

r. Remove the constant-amplitude generator signal from the right plug-in input connector, and connect the output of the low-frequency signal generator to the same connector.

s. Set the generator output for 60 Hz sine waves.

t. Set the B TIME/CM switch to 5 mSEC so several cycles of the waveform are displayed. and set the B Triggering SOURCE switch to RIGHT INT NORM. Adjust the plug-in unit vertical attenuator for a display 2 mm in amplitude.

u. Check—Stable displays may be obtained on the Lower Beam with the B Triggering COUPLING switch in the AC and AC HF REJ positions. The LEVEL control may be adjusted as necessary to obtain stable displays.

v. Increase the display amplitude to 3.5 mm.

w. Change the B Triggering COUPLING switch to DC.

x. Check—Stable displays may be obtained while adjusting the LEVEL control.

y. Change the generator to 30 Hz, and B TIME/CM switch to 10 mSEC, and adjust the display amplitude to 3 cm.

z. Change the B Triggering COUPLING switch to AC LF REJ.

aa. Check—No stable displays may be obtained while adjusting the LEVEL control.

ab. Change the generator frequency to 2.5 kHz, set the B TIME/CM switch to 1 mSEC, and adjust the amplitude of the display to 2 mm.

ac. Check—Stable displays may be obtained with adjustment of the LEVEL control.

20. Check Internal Triggering—Upper Beam

a. Requirement—Correct triggering with the following trigger coupling conditions and signal inputs:

AC:	2 mm 60 Hz to 10 MHz, increasing to 1 cm at 50 MHz.
AC LF REJ:	≥3 cm at 30 Hz, 2 mm 2.5 kHz to 10 MHz, increasing to 1 cm at 50 MHz.
AC HF REJ:	2 mm 60 Hz to 60 kHz, increasing to 1 cm at 6 MHz.
DC:	3.5 mm DC to 10 MHz, increasing to 2 cm at 50 MHz.

b. Set the A Triggering SOURCE switch to LEFT INT NORM, and the MODE switch to AUTO STABILITY.

c. Change the low-frequency generator output signal to the left plug-in unit input connector, and adjust the signal amplitude to 2 mm on the Upper Beam display.

d. Set the A TIME/CM switch to 1 mSEC.

e. Set the A Triggering COUPLING switch to AC LF REJ.

f. Check—Stable displays may be obtained on the Upper Beam while adjusting the LEVEL control.

NOTE

If desired, set the A Triggering MODE switch to TRIG when performing the "check" steps in this procedure (step 20). Use the AUTO STABILITY position between the "check" steps when setting up the display amplitude.

g. Change the generator frequency to 30 Hz, and change the A TIME/CM switch to 10 mSEC.

h. Adjust the signal amplitude to 3 cm.

i. Check—No stable display while adjusting the LEVEL control.

j. Change the generator frequency to 60 Hz, and the A TIME/CM switch to 5 mSEC.

k. Adjust the signal amplitude to 2 mm.

l. Check—Stable displays may be obtained with the COUPLING switch in AC, and AC HF REJ, while adjusting the LEVEL control.

m. Increase the amplitude of the display to 3.5 mm.

n. Change the COUPLING switch to DC.

o. Check—Stable displays may be obtained while adjusting the LEVEL control.

p. Remove the low-frequency signal, and connect the constant-amplitude signal generator output through a 50 ohm cable and 50-ohm termination to the left plug-in unit vertical input connector.

q. Set the generator frequency to 10 MHz.

r. Set the A TIME/CM switch to .2 μSEC, and adjust the left plug-in controls so the display is 2 mm in amplitude.

s. Check—Stable displays may be obtained on the Upper Beam with the A Triggering COUPLING switch in the AC and AC LF REJ positions. The LEVEL control may be adjusted as necessary to obtain a stable display.

t. Change the generator frequency to 50 MHz.

u. Set the A Triggering COUPLING switch to AC, and the A TIME/CM switch to .2 μSEC.

v. Change the DISPLAY MAG switch to ×10, and adjust the amplitude of the display to 1 cm.

w. Check—Stable displays may be obtained with adjustment of the LEVEL control.

x. Remove the constant amplitude generator signal from the left plug-in connector and connect the output of the low-frequency signal generator through a coaxial cable to the same connector.

y. Set the A Triggering COUPLING switch to AC HF REJ, the A TIME/CM switch to 50 μSEC, and return the Upper Beam DISPLAY MAG switch to ×1.

z. Set the generator frequency to 60 kHz and adjust the display amplitude to 2 mm.

aa. Check—Stable displays may be obtained with adjustment of the LEVEL control.

ab. Replace the low-frequency signal generator with the constant amplitude generator; set the generator frequency to 6 MHz. Set the Type 556 A TIME/CM switch to 15 μSEC, and the display amplitude to 1 cm.

ac. Check—No stable display with adjustment of the LEVEL control.

ad. Change the A Triggering SOURCE switch to PLUG-IN INT and the COUPLING switch to AC.

ae. Set the left plug-in Variable Volts/cm control to Calib and set the generator amplitude control for a 4 mm display on the Upper Beam.

af. Check—Stable displays may be obtained while adjusting the LEVEL control.

21. Check Crossover Triggering

a. Requirement—A stable display with a 2 mm signal at 10 MHz.

b. Set the Upper Beam DISPLAY switch to RIGHT PLUG-IN A, the A Triggering SOURCE to RIGHT INT NORM, the MODE switch to TRIG, and the A TIME/CM switch to .2 μSEC.

c. Set the B Triggering LEVEL fully clockwise, the MODE switch to AUTO STABILITY, the COUPLING switch to AC and the B TIME/CM switch to .2 μSEC.

d. Set the constant-amplitude signal generator to supply a 10 MHz signal and connect the signal to the right plug-in unit input connector. Adjust the right plug-in unit controls to display a signal 2 mm in amplitude on the Upper Beam.

e. Check—Stable display on the Upper Beam while adjusting the A Triggering LEVEL control.

f. Remove the generator signal.

22. Check Auto Stability Operation

a. Requirement—Sweep triggering at 30 Hz; free-running display with no signal.

b. Connect a 30 Hz sine-wave signal from a low-frequency generator to the right plug-in unit input connector and set the B TIME/CM switch to 10 mSEC.

c. Adjust the plug-in unit for a display 1 cm in amplitude.

d. Rotate the B Triggering LEVEL control from a fully counterclockwise position through 0 to the full clockwise position.

e. Check—Triggered (stable) display near the 0 position, and a free-running display in the remainder of the rotation area.

f. Remove the generator signal from the right plug-in unit connector and apply the signal to the left plug-in unit input connector.

g. Set the A Triggering SOURCE switch to LEFT INT NORM, MODE switch to AUTO STABILITY, Upper Beam DISPLAY switch to LEFT PLUG-IN A and the A TIME/CM switch to 10 mSEC.

h. Use steps (c) and (d) as a guide to check the A Triggering AUTO STABILITY operation.

i. Check—Triggered (stable) display near the 0 position, and a free-running display in the remainder of the rotation area.

j Remove the generator signal.

23. Check Line Trigger and LF Reject Operation

a. Requirement—Line triggering, must produce stable display of correct polarity; Slope, changes display polarity when switched; Low-Frequency Reject operation, does not trigger at line frequency.

b. Connect a 10× probe to the right plug-in unit input connector.

c. Preset the right plug-in unit vertical deflection to a factor (100 V/cm with 10× probe) that will permit an on-screen display when the signal in step (e) is applied.

d. Set the B TIME/CM switch to 5 mSEC.

e. Set the B Triggering SOURCE switching LINE RIGHT, and connect the probe tip to the oscilloscope line voltage source.

f. Check—Stable display with adjustment of the LEVEL control.

g. Change the SLOPE switch from + to —.

h. Check—Correct trigger polarity with the change of the SLOPE switch.

i. Change the SOURCE switch to NORM INT RIGHT.

j. Check—Stable display with adjustment of the LEVEL control.

k. Change the COUPLING switch to AC LF REJ.

l. Check—No stable display with adjustment of the LEVEL control.

m. Return the COUPLING switch to AC and remove the probe.

24. Check A and B Single Sweep Operation

a. Requirement—Sweep triggers with the same Triggering LEVEL control settings as in AUTO STABILITY; sweep locks out until reset.

b. Set the Standard Amplitude Calibrator to 1 volt square-wave output and apply the signal to the left plug-in unit input connector.

c. Set the left plug-in unit vertical deflection switch to 1 volt/cm and set the A TIME/CM switch to .5 mSEC.

d. With the variable volts/cm control, adjust the Upper Beam display amplitude for 5 mm, and adjust the A Triggering controls for a stable display.

e. Change the A MODE switch to SINGLE SWEEP, the A Triggering MODE switch to TRIG and remove the Standard Amplitude Calibrator signal from the left plug-in unit input connector.

f. Depress the A sweep RESET button, and note that the single-sweep indicator light is lit.

g. Re-apply the Standard Amplitude Calibrator signal to the input connector.

h. Check—The sweep runs once, and the indicator light is extinguished.

i. Use steps (c) through (g) as a guide for the B sweep, the right plug-in unit and Type 556 front-panel control settings.

j. Check—The B sweep runs once, and the indicator light is extinguished.

k. Return the A and B MODE switches to NORM, and remove the Standard Amplitude Calibrator signal.

25. Check Basic Timing-A Sweep

a. Requirement—Sweep rate ±3% of displayed time, ×1; ±5% of displayed time, ×10.

b. Remove the Type 1A1 units and install Test Load units in their place.

c. Set controls as follows:

A Triggering Controls	
SOURCE	LEFT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Near 0, knob pushed in
Upper Beam DISPLAY	LEFT PLUG-IN A
Upper Beam DISPLAY MAG	×1
A TIME/CM	1 mSEC
A VARIABLE	CALIBRATED
A MODE	NORM
B Triggering Controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Near 0, knob pushed in
Lower Beam DISPLAY	RIGHT PLUG-IN B
Lower Beam DISPLAY MAG	×1
B TIME/CM	1 mSEC
B VARIABLE	CALIBRATED
B MODE	NORM
Test Load Units (both)	
Test Function	Low Load

d. Connect a BNC T connector, two 50 Ω cables and two 50 Ω terminations from the time-mark generator to both Test Load unit Ext Input connectors.

e. Set the time-mark generator for 1-millisecond and 100-microsecond markers.

f. Adjust the A and B Triggering controls for stable displays in the Upper and Lower Beam graticule viewing areas.

g. Set the Upper Beam DISPLAY MAG switch to ×10.

h. Check—One 100-microsecond marker/cm ±5% or ±4 mm.

NOTE

When checking sweep timing, or when making time measurements from the graticule, the area between the first-cm and ninth-cm graticule lines provides the most linear measurement. Therefore the 0-cm to 1-cm and the 9-cm to 10-cm areas of the display should not be used for making accurate time measurements. See Fig. 2-7 in Selecting Sweep Rate, Section 2 of this manual.

i. Change the Upper Beam DISPLAY MAG switch to ×1.

j. Check—One 1-millisecond marker/cm, ±3% or 2.4 mm.

26. Check Upper Beam Sweep Magnifier Registration

a. Requirement—No more than 0.5 cm shift when switching the DISPLAY MAG switch from ×10 to ×1.

b. Set the Upper Beam DISPLAY MAG switch to ×10 and position the start of the trace to the graticule center vertical line.

c. Change the DISPLAY MAG switch to ×1.

d. Check—No more than 0.5 cm shift of the start of the trace as the DISPLAY MAG switch is changed from ×10 to ×1.

e. Check that Lower Beam DISPLAY MAG switch is set to ×1.

27. Check A Sweep Length

a. Requirement—Sweep length 10.5 cm ±5 mm.

b. Set the time-mark generator for 1-millisecond and 500-microsecond markers. Position the display to start at the 0-cm graticule line.

c. Check—The 22nd marker (counting the marker at the 0-cm graticule line) is just visible at the right hand edge of the graticule.

d. Return the DISPLAY MAG switch to ×10.

28. Check B Sweep Sawtooth Slope

a. Requirement—One 100-microsecond marker/cm on the Upper Beam display.

b. Set the Upper Beam DISPLAY switch to LEFT PLUG-IN B.

c. Set the time-mark generator for 1-millisecond and 100-microsecond markers.

d. Check—One 100-microsecond marker/cm on the Upper Beam display.

e. Return the DISPLAY MAG switch to ×1.

29. Check B Sweep Length

a. Requirement—Sweep length 10.5 cm ±5 mm.

b. Set the time-mark generator for 1-millisecond and 500-microsecond markers.

c. Check—The 22nd marker (counting the marker at the 0-cm graticule line) is just visible at the right-hand edge of the graticule.

30. Check Basic Timing—B Sweep

a. Requirement—Sweep rate ±3% of displayed time, ×1; ±5% of displayed time, ×10.

b. Set the Lower Beam DISPLAY switch to ×10, and position the display for optimum viewing.

c. Set the time-mark generator for 1-millisecond and 100-microsecond markers.

d. Check—One 100-microsecond marker/cm, ±5% or 4 mm.

e. Change the Lower Beam DISPLAY MAG switch to ×1.

f. Check—One 1-millisecond marker/cm, ±3% or 2.4 mm.

31. Check Lower Beam Sweep Magnifier Registration

a. Requirement—No more than 0.5 cm shift in the display when changing the DISPLAY MAG switch from ×10 to ×1.

b. Set the Lower Beam DISPLAY MAG switch to ×10 and position the start of the trace to the graticule center vertical line.

c. Change the DISPLAY MAG switch to ×1.

d. Check—No more than 0.5 cm shift of the start of the trace as the DISPLAY MAG switch is changed from ×10 to ×1.

e. Return the DISPLAY MAG switch to ×1 and disconnect the time-markers from the Type 556.

32. Check Delay-Time Multiplier Dial Setting

a. Requirement—Counterclockwise reading, 0.20 ±2 minor divisions; clockwise reading, 10.20 ±4 minor divisions.

b. Rotate the DELAY-TIME MULTIPLIER dial fully counterclockwise until it hits the stop.

NOTE

If dial is reset, delayed-sweep calibration will be changed and it will be necessary to perform a recalibration of the A sweep (steps 45 through 48 in the Calibration Procedure).

c. Check—Dial reading of 0.20, ±2 minor divisions.

d. If the dial reading is not 0.20 (within ±2 minor divisions), loosen the knob setscrew and reposition the knob so that the fully counterclockwise position reading is correct.

e. Rotate the DELAY-TIME MULTIPLIER dial fully clockwise.

f. Check—Dial reading of 10.20, ±4 minor divisions.

33. Check Delay Start and Stop

a. Requirement—Intensified portion of the display starts at the 2nd and 10th markers with the DELAY-TIME MULTIPLIER dial set to 1.00 ±10 minor divisions, and 9.00 ±10 minor divisions, respectively, with a difference of 800 minor divisions ±8 minor divisions between the two dial readings.

b. Set controls as follows:

A Triggering Controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Near 0, knob pushed in
Upper Beam DISPLAY	RIGHT PLUG-IN A
Upper Beam DISPLAY MAG	×1
A TIME/CM	1 mSEC
A VARIABLE	CALIBRATED
A MODE	NORM
B Triggering Controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Fully clockwise, knob pulled outward
Lower Beam DISPLAY	RIGHT PLUG-IN B
Lower Beam DISPLAY MAG	×1
B TIME/CM	10 μSEC
B VARIABLE	CALIBRATED
B MODE	NORM
Test Load Units (both)	
Test Function	Low Load

c. Connect a 50 Ω cable from the time-mark generator through a 50 Ω termination to the right test load unit Ext Input connector.

d. Set the time-mark generator for 1-millisecond markers.

e. Adjust the A Triggering controls for a stable display on the Upper Beam.

f. Adjust the TRACE SEPARATION and right test load unit Variable and Vertical Position controls for convenient viewing of the Upper and Lower Beam displays.

g. Change the B MODE switch to DLY'D BY A.

NOTE

Adjustment of the Upper Beam INTENSITY and CONTRAST controls may be necessary for optimum viewing of the intensified portion of the display.

h. Adjust the DELAY-TIME MULTIPLIER dial so that the intensified portion of the Upper Beam display starts at the 2nd marker.

i. Check—The dial reading should be 1.00 ±10 minor divisions.

j. Adjust the DELAY-TIME MULTIPLIER dial so that the intensified portion of the Upper Beam display starts at the 10th marker.

k. Check—The dial reading should be 9.00 ±10 minor divisions.

l. Check—The difference obtained between the dial readings obtained in steps (i) and (k) should be 800 minor divisions ±8 minor divisions.

34. Check Delay-Time Multiplier Incremental Linearity

a. Requirement—Deviation of DELAY-TIME MULTIPLIER readings between adjacent major dial divisions not more than ±2 minor divisions from 1.00 to 9.00.

b. Set the DELAY-TIME MULTIPLIER dial to 8.00.

c. Rotate the dial as necessary to position the delayed pulse to start at the 0-cm graticule line.

d. Check—Deviation of dial reading from 8.00 should be not more than ±2 minor divisions on the dial as compared to the deviation from 9.00 of the previous dial reading. For example, if the dial reading from 9.00 is 9.04, the reading from 8.00 should be 8.04 ±2 minor divisions.

e. Repeat check at all major divisions from 8.00 to 1.00.

35. Check Delay-Time Jitter

a. Requirement—Jitter not more than 0.5 cm.

b. Change the B TIME/CM switch to 1 μSEC.

c. Set the DELAY-TIME MULTIPLIER dial to 10.00 approximately, centering the magnified pulse near the center of the graticule.

d. Check—Jitter not more than 0.5 cm.

e. Set the DELAY-TIME MULTIPLIER dial to 1.00 approximately, centering the magnified waveform near the center of the graticule.

f. Check—Jitter not more than 0.5 cm.

36. Check Horizontal Amplifier 50 MHz Compensation—Upper Beam

a. Requirement—Timing accuracy ±5% (or ±4 mm) 4 cm from sweep start to 70 cm from sweep start.

b. Set the controls as follows:

A Triggering Controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Near 0, knob pushed in
Upper Beam DISPLAY	RIGHT PLUG-IN A
Upper Beam DISPLAY MAG	×1
A TIME/CM	0.1 μSEC
A VARIABLE	CALIBRATED
A MODE	NORM
B Triggering Controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Fully clockwise, knob pulled outward
Lower Beam DISPLAY	RIGHT PLUG-IN B
Lower Beam DISPLAY MAG	×10
B TIME/CM	1 μSEC
B VARIABLE	CALIBRATED
B MODE	NORM
DELAY-TIME MULTIPLIER	1.00
Test Load Units (both)	
Test Function	Low Load

c. Change the B MODE switch to SINGLE SWEEP (this disables the B sweep).

d. Set the time-mark generator for 50 MHz (20 ns) sine-wave output.

e. Connect a 10-microsecond trigger signal from the time-mark generator Trigger Output connector through a 50 Ω *cable and* 50 Ω *termination* to the Upper Beam TRIGGER INPUT connector.

f. Set the A Triggering SOURCE switch to EXT and adjust the LEVEL control to obtain a stable display.

g. Position the display so the Upper Beam waveform starts at the 0-cm graticule line. (Turn up the INTENSITY control temporarily to see the start of the waveform for proper positioning.)

h. Change the Upper Beam DISPLAY MAG switch to ×10.

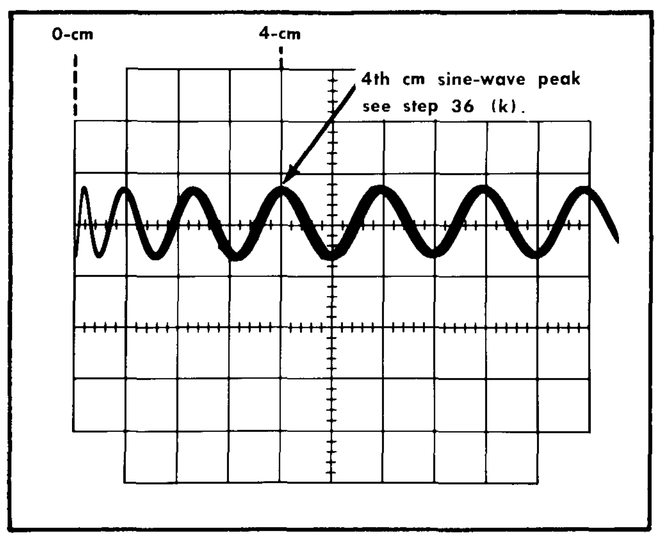


Fig. 5-6. Typical display, high-speed sweep timing, showing peak of a sine wave at the 4-cm graticule line, see step 36 (k).

i. Position the sine waves to align with the vertical graticule lines.

j. Check—One cycle/2 cm, Upper Beam display. The 1-cm and 9-cm sine-wave peaks should coincide with their respective graticule lines. Tolerance is ±5% or ±4 mm. Position the display 10 cycles to the left and recheck timing accuracy.

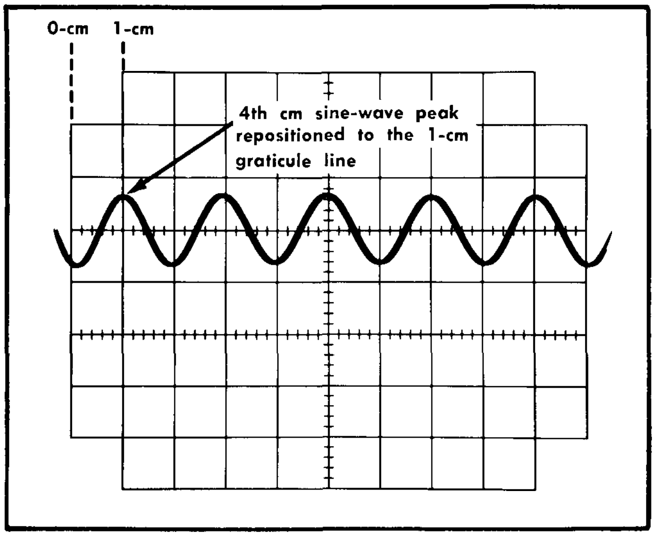


Fig. 5-7. Typical display showing 4th cm sine wave of Fig. 5-6 repositioned to the 1-cm graticule line, as in step 36 (l).

k. Position the display so the Upper Beam waveform starts at the 0-cm graticule line. (Turn up the INTENSITY control temporarily to check that the waveform is properly positioned. See Fig. 5-6.)

l. Adjust the A Triggering LEVEL control so a sine-wave peak (top or bottom) falls on the 4-cm graticule vertical line. Note that sine-wave peak and position it to the 1-cm graticule vertical line. (See Fig. 5-7.)

m. Check—One cycle/2 cm, Upper Beam display; 1-cm, 5-cm and 9-cm sine-wave peaks should coincide with their respective graticule vertical lines (see Fig. 5-8). Tolerance is ±5% or ±4 mm.

n. Change the Upper Beam DISPLAY MAG switch to ×1 and reposition the display to start at the 0-cm graticule vertical line.

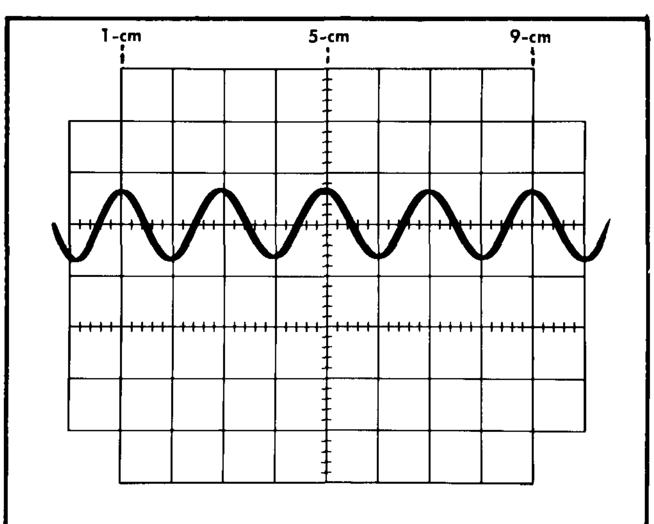


Fig. 5-8. Typical display, correct high speed sweep timing and linearity.

37. Check Timing and Delaying Sweep Accuracy—A Sweep

a. Requirement—A Sweep accuracy, ±3% or ±2.4 mm; delaying sweep, within 8 minor divisions of the DELAY-TIME MULTIPLIER dial for each position of the A TIME/CM switch.

b. Change the B MODE switch to DLY'D BY A, and check that the Lower Beam DISPLAY switch is set to ×10.

c. Check—Using Table 5-2 as a guide, check the A Sweep CRT displayed accuracy with respect to the 1-cm and 9-cm graticule vertical lines. Tolerance should be within ±3% or ±2.4 mm. In addition, check the delayed sweep accuracy using the DELAY-TIME MULTIPLIER dial. Tolerance should be within 8 minor divisions for each A TIME/CM switch position. The technique for checking the three fastest sweep rates using the DELAY-TIME MULTIPLIER dial is as follows:

For the 0.1 μSEC A TIME/CM switch position, the basic technique is described in steps 48s through 48aa of the Calibration Procedure. For the 0.2 μSEC switch position the technique is similar to the 0.1 position, but 16 markers must be counted on the Lower Beam display when rotating the

TABLE 5-2

Timing and Delaying Sweep Accuracy—A Sweep

A TIME/CM	B TIME/CM	Time Mark Generator	Check Upper Beam Display[1]
0.1 μSEC	0.1 μSEC[2]	0.1 μs	1 marker/cm
0.2 μSEC	0.1 μSEC[2]	0.1 μs	2 markers/cm
0.5 μSEC[3]	0.1 μSEC	0.5 μs	1 marker/cm
1 μSEC	0.1 μSEC	1 μs	1 marker/cm
2 μSEC	0.2 μSEC	1 μs	2 markers/cm
5 μSEC	0.5 μSEC	5 μs	1 marker/cm
10 μSEC	1 μSEC	10 μs	1 marker/cm
20 μSEC	2 μSEC	10 μs	2 markers/cm
50 μSEC	5 μSEC	50 μs	1 marker/cm
0.1 mSEC	10 μSEC	0.1 ms	1 marker/cm
0.2 mSEC	20 μSEC	0.1 ms	2 markers/cm
0.5 mSEC	50 μSEC	0.5 ms	1 marker/cm
1 mSEC	0.1 mSEC	1 ms	1 marker/cm
2 mSEC	0.2 mSEC	1 ms	2 markers/cm
5 mSEC	0.5 mSEC	5 ms	1 marker/cm
10 mSEC	1 mSEC	10 ms	1 marker/cm
20 mSEC	2 mSEC	10 ms	2 markers/cm
50 mSEC	5 mSEC	50 ms	1 marker/cm
0.1 SEC	10 mSEC	0.1 s	1 marker/cm
0.2 SEC	20 mSEC	0.1 s	2 markers/cm
0.5 SEC	50 mSEC	0.5 s	1 marker/cm
1 SEC	0.1 SEC	1 s	1 marker/cm
2 SEC	0.2 SEC	1 s	2 markers/cm
5 SEC	0.5 SEC	5 s	1 marker/cm

[1]Use CONTRAST control to check display.

[2]Lower Beam DISPLAY MAG switch is set to ×10. (For the remaining B TIME/CM switch positions, the switch is set to ×1.)

[3]Set the A Triggering SOURCE switch to RIGHT INT NORM and the MODE switch set to TRIG.

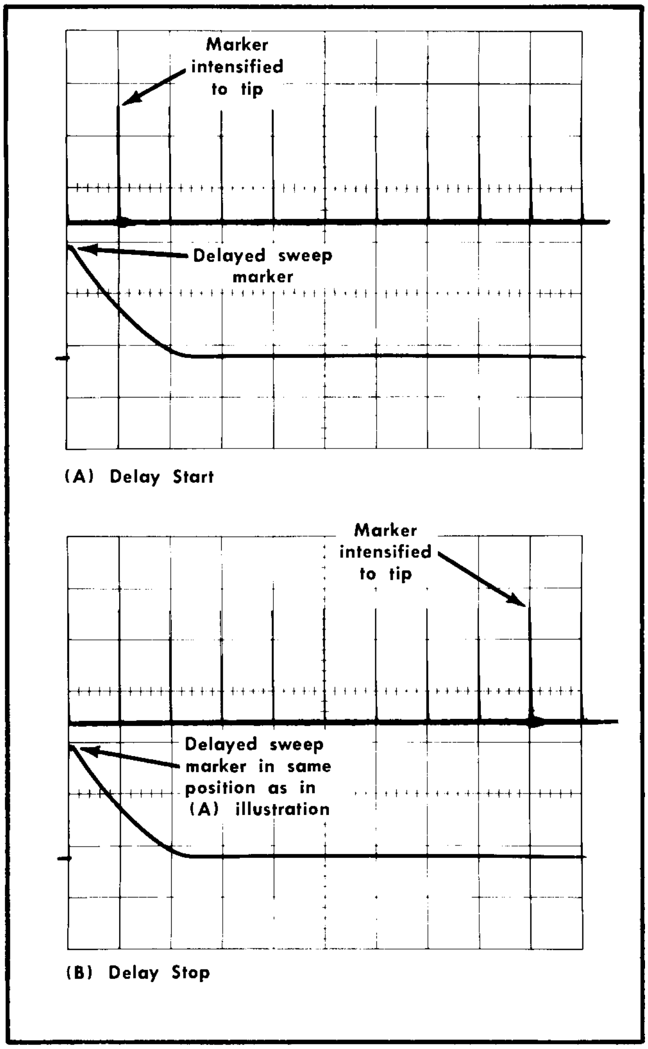


Fig. 5-9. Typical displays, Delay Start and Stop adjustments check.

dial from 1.00 to 9.00. Check dial reading from 9.00 at intercept point. For the 0.5 μSEC switch position, set the A Triggering SOURCE switch to RIGHT INT NORM, the Lower Beam DISPLAY MAG switch to ×1 and use a similar technique to that described in steps 48c through 48f of the Calibration Procedure

For the A TIME/CM switch position from 1 μSEC to 5 SEC, use a similar technique for checking delaying sweep accuracy to that used when checking the Delay Start and Stop adjustments (step 33) and as shown in Fig. 5-9.

38. Check B Sweep Crossover Compensation

a. Requirement—Timing accuracy ±3%, Upper Beam display.

b. Set the Type 556 and plug-in unit controls as follows:

A Triggering Controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	TRIG
LEVEL	Fully clockwise, knob pushed in
Upper Beam DISPLAY	RIGHT PLUG-IN B
Upper Beam DISPLAY MAG	×1
A TIME/CM	1 mSEC
A VARIABLE	CALIBRATED
A MODE	NORM
B Triggering Controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Near 0, knob pushed in
Lower Beam DISPLAY	RIGHT PLUG-IN B
Lower Beam DISPLAY MAG	×1
B TIME/CM	.1 μSEC
B VARIABLE	CALIBRATED
B MODE	NORM
Test Load Units (both)	
Test Function	Low Load

c. Set the time mark generator for 0.1-microsecond markers.

d. Remove the 10-μs trigger signal from the Upper Beam TRIGGER INPUT connector and apply the signal to the Lower Beam TRIGGER INPUT connector.

e. Set the B Triggering SOURCE switch to EXT and check that the Upper Beam DISPLAY switch is set to RIGHT PLUG-IN B.

f. Check—One marker/cm, Upper Beam display, ±2.4 mm.

39. Check Horizontal Amplifier 50 MHz Compensation—Lower Beam

a. Requirement—Timing accuracy ±5% (or ±4 mm) from the 1-cm to 9-cm graticule vertical lines.

b. Change the Upper Beam DISPLAY switch to LEFT PLUG-IN A.

c. Set the time-mark generator for 50 MHz (20 ns) sine-wave output.

d. Adjust the B Triggering LEVEL control to obtain a stable display.

e. Position the display so the Lower Beam waveform starts at the 0-cm graticule line. (Turn up the INTENSITY control temporarily to see the start of the waveform for proper positioning.)

f. Change the Lower Beam DISPLAY MAG switch to ×10.

g. Position the sine waves to align with the graticule vertical lines.

h. Check—One cycle/2 cm, Lower Beam display. The 1-cm and 9-cm sine-wave peaks should coincide with their respective graticule vertical lines. Tolerance is ±5% or ±4 mm. Position the display 10 cycles to the left and recheck timing accuracy.

i. Position the display so the Lower Beam waveform starts at the 0-cm graticule vertical line. (Turn up the INTENSITY control temporarily to check that the waveform is properly positioned. Use Fig. 5-6 as a guide.)

j. Adjust the B Triggering LEVEL control so a sine-wave peak (top or bottom) falls on the 4-cm graticule vertical line. Note the sine-wave peak and position it to the 1-cm graticule line. (Use Fig. 5-7 as a guide.)

k. Check—One cycle/2 cm, Lower Beam display; 1-cm, 5-cm and 9-cm sine-wave peaks should coincide with their respective graticule lines. Tolerance is ±5% or ±4 mm.

40. Check Timing Accuracy—B Sweep

a. Requirement—Timing accuracy ±3% (2.4 mm).

b. Change the B Triggering MODE switch to TRIG, the SOURCE switch to INT NORM and the Lower Beam DISPLAY MAG switch to ×1.

c. Disconnect the trigger signal from the Lower Beam TRIGGER INPUT connector.

d. Check—Using Table 5-3 as a guide, check the B sweep CRT displayed accuracy with respect to the 1-cm and 9-cm graticule vertical lines. Tolerance should be within ±3% or ±2.4 mm.

TABLE 5-3

Timing Accuracy—B Sweep

B TIME/CM	Time Mark Generator	Check Lower Beam Display
0.1 μSEC	0.1 μs	1 marker/cm
0.2 μSEC	0.1 μs	2 markers/cm
0.5 μSEC	0.5 μs	1 marker/cm
1 μSEC	1 μs	1 marker/cm
2 μSEC	1 μs	2 markers/cm
5 μSEC	5 μs	1 marker/cm
10 μSEC	10 μs	1 marker/cm
20 μSEC	10 μs	2 markers/cm
50 μSEC	50 μs	1 marker/cm
0.1 mSEC	0.1 ms	1 marker/cm
0.2 mSEC	0.1 ms	2 markers/cm
0.5 mSEC	0.5 ms	1 marker/cm
1 mSEC	1 ms	1 marker/cm
2 mSEC	1 ms	2 markers/cm
5 mSEC	5 ms	1 marker/cm
10 mSEC	10 ms	1 marker/cm
20 mSEC	10 ms	2 markers/cm
50 mSEC	50 ms	1 marker/cm
0.1 SEC	0.1 s	1 marker/cm
0.2 SEC	0.1 s	2 markers/cm
0.5 SEC	0.5 s	1 marker/cm
1 SEC	1 s	1 marker/cm
2 SEC	1 s	2 markers/cm
5 SEC	5 s	1 marker/cm

41. Check Variable Time/cm Range

a. Requirement—At least 2.5:1 reduction in A and B Sweep rates.

b. Set the Upper Beam DISPLAY switch to RIGHT PLUG-IN A.

c. Set the B TIME/CM to 1 mSEC.

d. Set the A and B Triggering MODE switches to AUTO STABILITY.

e. Check that the A Triggering SOURCE switch is set to RIGHT INT NORM.

f. Set the time-mark generator for 10-millisecond markers.

g. Adjust the A and B Triggering LEVEL controls to obtain stable Upper and Lower Beam displays. Markers on both beams will appear at the 0-cm and 10-cm graticule vertical lines.

h. Rotate the A and B TIME/CM VARIABLE controls fully counterclockwise; the UNCAL lights should be on.

i. Check—Horizontal distance between markers should be 4 cm or less, both displays.

j. Return both VARIABLE controls to CALIBRATED; the UNCAL lights should be off.

42. Check Trigger Delay

a. Requirement—Trigger delay equal to or less than 150 nanoseconds.

b. Preset the Type 556 controls as follows:

B MODE	DLY'D BY A
A and B TIME/CM	.1 μSEC
A Triggering	TRIG, +, AC, NORM INT, RIGHT
B Triggering	AUTO STABILITY, +, AC, NORM INT, RIGHT, LEVEL control fully clockwise with knob pulled outward
DELAY-TIME MULTIPLIER	10.00

c. Set the time-mark generator for 1-microsecond marker output.

d. Adjust the A triggering LEVEL control to obtain a stable display.

e. With the Upper and Lower Beam POSITION controls, position both traces to start at the 0-cm graticule vertical line.

f. Turn the DELAY-TIME MULTIPLIER dial counterclockwise while adjusting the TRACE SEPARATION and right plug-in Vertical Position controls until the marker on the Lower Beam display is superimposed on the Upper Beam marker.

g. Check—Dial reading difference from 10.00 equal to or less than 150 nanoseconds. (One minor dial division equals one nanosecond.)

h. Disconnect the marker signal from the right plug-in unit.

43. Check External Horizontal Amplifier DC Balance—Upper Beam

a. Requirement—No more than ±5 cm horizontal shift of the left edge of the display as the UPPER BEAM EXT HORIZ VAR 1-10 control is rotated.

b. Set the controls as follows:

A Triggering Controls	
SOURCE	LEFT EXT
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Near 0, knob pushed in
Upper Beam DISPLAY	LEFT PLUG-IN EXT
Upper Beam DISPLAY MAG	×10
A TIME/CM	1 mSEC
A VARIABLE	CALIBRATED
A MODE	NORM
B Triggering Controls	
SOURCE	RIGHT EXT
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Near 0, knob pushed in
Lower Beam DISPLAY	RIGHT PLUG-IN EXT
Lower Beam DISPLAY MAG	×10
B TIME/CM	1 mSEC
B VARIABLE	CALIBRATED
B MODE	NORM
Test Load Units (both)	
Test Function	Low Load

c. Set the Standard Amplitude Calibrator to supply a 0.5-volt square wave signal.

d. Connect the signal through a BNC T connector to the A Triggering TRIGGER INPUT connector and the UPPER BEAM EXT HORIZ IN connector.

e. Connect a patch cord from the A SAWTOOTH connector to the left test load unit Ext Input connector.

f. Rotate the UPPER BEAM EXT HORIZ VAR 1-10 control fully clockwise.

g. Adjust the left test load unit Variable control to display 4 or 5 cycles of the waveform in the Upper Beam graticule area.

h. Position the left edge of the display to the center vertical line of the graticule.

i. Rotate the UPPER BEAM EXT HORIZ VAR 1-10 control from fully clockwise to fully counterclockwise, then fully clockwise.

j. Check—No more than ±5 cm horizontal shift of the left edge of the display as the VAR 1-10 control is rotated.

k. Return the VAR 1-10 control fully clockwise.

44. Check External Horizontal Amplifier Variable Control Range—Upper Beam

a. Requirement—At least a 10:1 ratio of horizontal deflection control.

b. Position the left edge of the display to the 2-cm graticule line.

c. Check—5 cm or more of horizontal deflection.

d. Rotate the UPPER BEAM EXT HORIZ VAR 1-10 control fully counterclockwise.

e. Check—Horizontal deflection equal to or less than 10% of the deflection noted in step (c).

f. Return the VAR 1-10 control fully clockwise.

45. Check External Horizontal Amplifier ×10 Compensation—Upper Beam

a. Requirement—Front corner of waveform showing no more than 3% overshoot, rolloff, or ringing.

b. Check—Front corner of waveform should be similar to Fig. 5-10, showing no more than 3% overshoot, rolloff, or ringing.

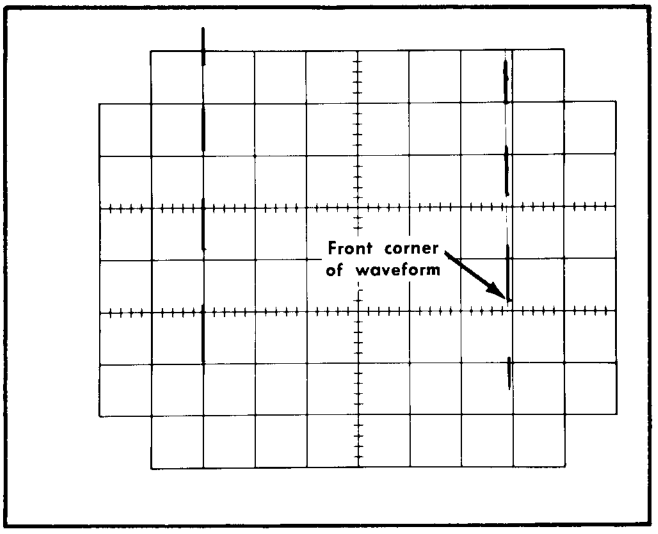


Fig. 5-10. Typical display, External Horizontal Amplifier Compensation check.

46. Check External Horizontal Amplifier ×1 Compensation—Upper Beam

a. Requirement—Front corner of waveform showing no more than 3% overshoot, rolloff, or ringing.

b. Change the DISPLAY MAG switch to ×1.

c. Change the Standard Amplitude Calibrator output to 5 volts. Note amount of horizontal deflection because this information will be checked foı step 47 (b).

d. Check—Front corner of waveform similar to Fig. 5-10, and showing no more than 3% overshoot, rolloff, or ringing.

47. Check Magnifier ×1-×10 Ratio Accuracy—Upper Beam

a. Requirement—Ratio of 10:1, within 3%.

b. Measure the horizontal deflection of the display observed in step 46(c).

c. Change the Standard Calibrator output to 0.5 volts.

d. Change the DISPLAY MAG switch to ×10.

e. Check—Horizontal deflection of the display should be within 3% of the display noted in step 46 (c).

f. Set the Upper Beam INTENSITY control so the display is not visible.

48. Check External Horizontal Amplifier DC Balance—Lower Beam

a. Requirement—No more than ±5 cm horizontal shift of the left edge of the display as the LOWER BEAM EXT HORIZ VAR 1-10 control is rotated.

b. Move the Standard Amplitude Calibrator signal to the LOWER BEAM EXT HORIZ IN connector, and to the B Triggering EXT TRIGGER INPUT connector.

c. Move the patch cord to connect the B SAWTOOTH connector to the right test load unit Ext Input connector.

d. Rotate the LOWER BEAM EXT HORIZ IN VAR 1-10 fully clockwise.

e. Adjust the right test load unit Variable control to display 4 or 5 cycles of the waveform in the Lower Beam graticule area.

f. Position the left edge of the display to the center vertical line of the graticule.

g. Rotate the LOWER BEAM EXT HORIZ VAR 1-10 from fully clockwise to fully counterclockwise, then fully clockwise.

h. Check—No more than ±5 cm horizontal shift of the left edge of the display as the VAR 1-10 control is rotated.

i. Return the VAR 1-10 control fully clockwise.

49. Check External Horizontal Amplifier Variable Control Range—Lower Beam

a. Requirement—Horizontal deflection control ratio of at least 10:1.

b. Position the left edge of the display to the 2-cm graticule vertical line.

c. Check—Horizontal deflection of the display 5 cm or more.

d. Rotate the LOWER BEAM EXT HORIZ VAR 1-10 control fully counterclockwise.

e. Check—Horizontal deflection equal to or less than 10% of the deflection noted in step (c).

f. Return the VAR 1-10 control fully clockwise.

50. Check External Horizontal Amplifier ×1 and ×10 Compensation—Lower Beam

a. Requirement—Front corner of waveform showing no more than 3% overshoot, rolloff, or ringing.

b. Check—Front corner of waveform similar to Fig. 5-10, and showing no more than 3% overshoot, rolloff, or ringing.

c. Change the DISPLAY MAG to ×1.

d. Change the Standard Amplitude Calibrator output to 5 volts. Note amount of horizontal deflection because this information will be needed for step 51 (b).

e. Check—Front corner of waveform similar to Fig. 5-10, and showing no more than 3% overshoot, rolloff, or ringing.

51. Check Magnifier ×1-×10 Ratio Accuracy—Lower Beam

a. Requirement—Ratio of 10:1, within 3%.

b. Measure the horizontal deflection of the display noted in step 50 (d).

c. Change the Standard Calibrator output to 0.5 volts.

d. Change the DISPLAY MAG switch to ×10.

e. Check—Horizontal deflection of the display should be within 3% of the deflection noted in step 50 (b).

f. Reduce the Lower Beam intensity. Remove the Standard Calibrator signal and the patch cord.

g. Return the A and B Triggering SOURCE switches to NORM INT, and both DISPLAY MAG switches to ×1.

h. Set the Upper Beam DISPLAY switch to LEFT PLUG-IN A and the Lower Beam DISPLAY switch to RIGHT PLUG-IN B.

52. Check Z Axis Operation—Upper and Lower Beams

a. Requirement—Noticeable intensity modulation with 10-volt input signal.

b. Set the AMPLITUDE CALIBRATOR to 10 VOLTS.

c. Check that both CRT Cathode Selector switches (on rear panel) are set to EXT CRT CATHODE.

d. Adjust the INTENSITY controls of both beams for normal viewing.

e. Remove the two BNC shorting-type caps (on rear panel) from the BNC connectors.

f. Connect a 50 Ω cable from the CAL OUT connector to the Upper Beam BNC conector on the rear panel.

g. Check that the A and B TIME/CM switches are set to 1 mSEC.

h. Check—Upper Beam CRT display for noticeable intensity modulation (see Fig. 5-11). (INTENSITY setting may have to be reduced to view trace modulation.)

i. Move the CAL OUT signal to the Lower Beam BNC connector.

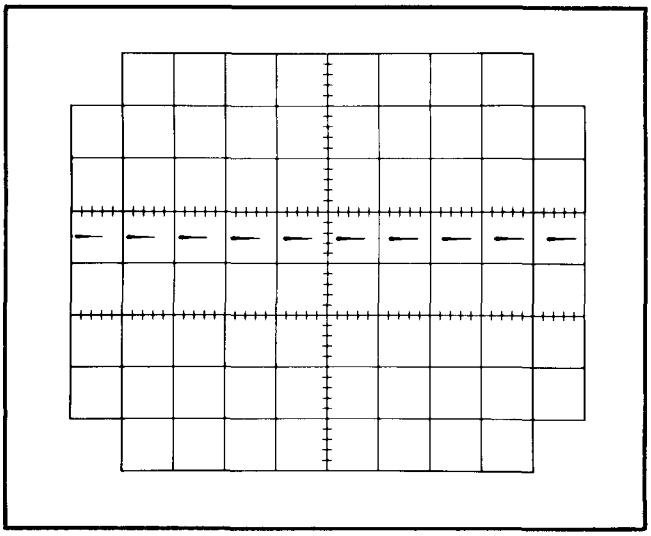


Fig. 5-11. Typical display, intensity modulation (Z Axis Operation).

j. Check—Lower Beam CRT display for intensity modulation, as in step (h).

k. Remove the AMPLITUDE CALIBRATOR signal and replace both BNC caps.

53. Check A Sweep Sawtooth Amplitude

a. Requirement—Sawtooth waveform amplitude equal to or greater than 94.5 volts for a 10.5-cm A Sweep.

b. Set controls as follows:

A Triggering Controls	
SOURCE	LEFT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Fully clockwise, knob pushed in
Upper Beam DISPLAY	LEFT PLUG-IN A
Upper Beam DISPLAY MAG	×1
A TIME/CM	1 mSEC
A VARIABLE	CALIBRATED
A MODE	NORM
B Triggering Controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Fully clockwise, knob pushed in
Lower Beam DISPLAY	RIGHT PLUG-IN B
Lower Beam DISPLAY MAG	×1
B TIME/CM	1 mSEC
B VARIABLE	CALIBRATED
B MODE	NORM
Test Load Units (both)	
Test Function	Low Load
Test Oscilloscope	
Time/cm	5 milliseconds

c. Connect a 10× probe to the test oscilloscope vertical amplifier input connector.

d. Set the test oscilloscope vertical deflection switch to 5 volts/cm.

e. Connect the probe tip to the A SAWTOOTH connector, and adjust the test oscilloscope triggering for a stable display.

f. Check—Test oscilloscope display amplitude of 94.5 volts or more (equal to or greater than 9 volts per cm for the A sweep).

54. Check B Sweep Sawtooth Amplitude

a. Requirement—Sawtooth waveform amplitude equal to or greater than 94.5 volts for a 10.5-cm B sweep.

b. Move the probe tip to the B SAWTOOTH connector.

c. Check—Test oscilloscope display amplitude of 94.5 volts or more (equal to or greater than 9 volts per cm for the B sweep).

55. Check A Sweep Gate Amplitude

a. Requirement—Gate waveform amplitude 10 volts or more.

b. Connect the probe tip to the A GATE connector.

c. Change the test oscilloscope vertical deflection switch to 0.5 volts/cm.

d. Check—Gate waveform amplitude 10 volts or more.

56. Check B Sweep Gate Amplitude

a. Requirement—Gate waveform amplitude 10 volts or more.

b. Move the probe tip to the B GATE connector.

c. Check—Gate waveform amplitude 10 volts or more.

57. Check Delayed Trigger Waveform Amplitude

a. Requirement—Delayed trigger pulse amplitude 7 volts or more.

b. Change the test oscilloscope time/cm switch to 1 microsecond.

c. Check that the vertical deflection switch is set to 0.5 volts/cm.

d. Move the probe tip to the DLY'D TRIG connector.

e. Rotate the A TIME/CM switch through all positions.

f. Check—Delayed trigger pulse amplitude 7 volts or more.

NOTE

Adjustment of the test oscilloscope intensity control may be necessary to observe the pulse at the slower sweep rates.

g. Remove the probe.

58. Check Vertical Amplifier Transient Response

a. Requirement—Waveform showing ≤2.25% peak overshoot, rolloff, or ringing.

b. Set the controls as follows:

A Triggering Controls	
SOURCE	LEFT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Near 0, knob pushed in
Upper Beam DISPLAY	LEFT PLUG-IN A
Upper Beam DISPLAY MAG	×1
A TIME/CM	.1 mSEC
A VARIABLE	CALIBRATED
A MODE	NORM
B Triggering Controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Near 0, knob pushed in
Lower Beam DISPLAY	RIGHT PLUG-IN B
Lower Beam DISPLAY MAG	×1
B TIME/CM	.1 mSEC
B VARIABLE	CALIBRATED
B MODE	NORM
Test Load Units (both)	
Test Function	+ Pulse
Pulse Repetition Rate	Low

c. Adjust the right plug-in unit Vertical Position control to move the Lower Beam below the viewing area.

d. With the left plug-in unit Vertical Position control, center the display within the Upper Beam viewing area.

e. Adjust the amplitude of the display to 5 cm with the left plug-in unit Amplitude control. Use the left plug-in unit Vertical Position control to keep the display centered within the Upper Beam viewing area.

f. Check—Upper Beam CRT display for flat top.

g. Change the left plug-in unit Pulse Repetition Rate control to Med.

h. Change the A TIME/CM switch to .1 μSEC.

i. Set the Upper Beam POSITION control so the rising portion of the pulse is located near the center of the graticule.

j. With the left plug-in unit Vertical Position control, move the waveform so the front corner is located 3 cm above the Upper Beam graticule center horizontal line. Note the appearance of the front corner of the waveform.

k. Using the left plug-in unit Vertical Position control, move the flat top portion of the display 3 cm below the Upper Beam graticule center horizontal line.

l. Check—For no change in front corner of the waveform. Allowable front corner change is ≤2.25% of 50 mm or ≤1.125 mm.

m. Change the left plug-in unit Test Function switch to —Pulse, and the Type 556 A Triggering SLOPE switch to —. The waveform will now appear as a negative-going pulse.

n. Repeat step (j) through (l) but position the lower leading corner of the waveform to the same points described in the steps.

o. Check—Change in front corner of the waveform should be ≤2.25% of 50 mm or ≤1.125 mm.

p. Change the left plug-in unit Test Function switch to +Pulse, and the Type 556 A Triggering SLOPE switch to +.

q. Adjust the left plug-in unit Vertical Position control to move the Upper Beam display below the viewing area.

r. Repeat steps (d) and (e) for the right plug-in unit and Lower Beam.

s. Check—Lower Beam CRT display for flat top.

t. Repeat steps (g) through (k) for the right plug-in unit and Lower Beam.

u. Check—For no change in front corner of the waveform. Allowable front corner change is ≤2.25% of 50 mm or ≤1.125 mm.

v. Repeat steps (m) and (n) for the right plug-in unit and Lower Beam.

w. Check—Change in front corner of the waveform should be ≤2.25% of 50 mm or ≤1.125 mm.

x. Change the right plug-in unit Test Function switch to + Pulse, and the Type 556 B Triggering SLOPE switch to +.

y. Change the A Triggering SOURCE switch to RIGHT INT NORM, and the Upper Beam DISPLAY switch to RIGHT PLUG-IN A.

z. With the TRACE SEPARATION and right plug-in unit Vertical Position controls, position the rising portion of the displays near their respective graticule centers.

aa. Set the Lower Beam INTENSITY control so the Lower Beam is not visible.

ab. Check—Upper Beam CRT display for optimum square corner and flat top, with peak overshoot, rolloff, or ringing ≤2.25% of 50 mm or ≤1.125 mm. See Fig. 5-12 for a typical display.

59. Check Vertical Amplifier Risetime-Crossover

a. Requirement—Risetime of the 10% to 90% portion of the rising portion should be 6.93 nanoseconds or less with the test load unit pulse risetme of 3 nanoseconds. Fig. 5-13 shows a typical display.

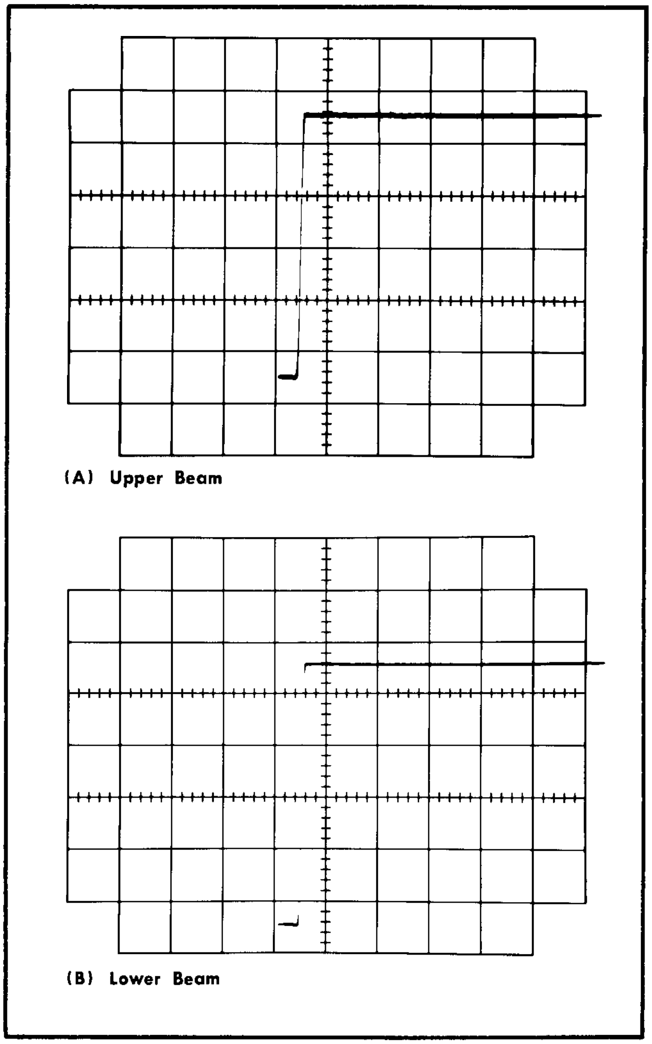


Fig. 5-12. Typical displays, high frequency compensations correctly adjusted.

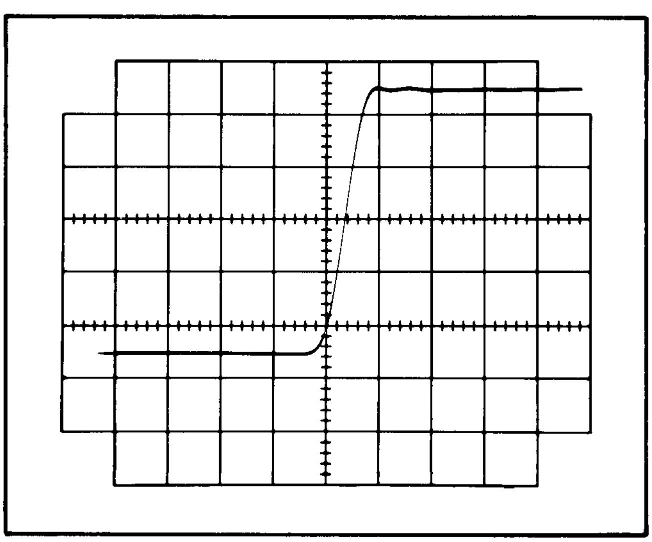


Fig. 5-13. Correct positioning of Upper Beam waveform for risetime check.

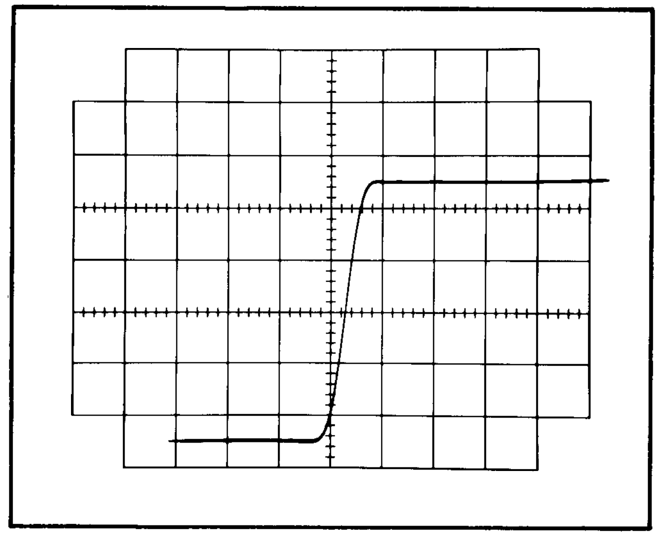


Fig. 5-14. Correct positioning of Lower Beam waveform for risetime check.

NOTE

When performing steps 59 through 61, take into consideration sweep timing error, if any, and/or geometry and orthogonality in the area where the measurement is made.

b. Set the Upper Beam DISPLAY MAG switch to ×10.

c. With the TRACE SEPARATION and Upper Beam POSITION controls, position the Upper Beam 5-cm display so that the 10% point on the rising portion of the waveform crosses the intersection of the Upper Beam graticule center horizontal line with the graticule center vertical line. Fig. 5-13 shows the correct positioning of the display.

d. Check—Risetime of the 10% to 90% portion of the pulse risetime should be 6.93 nanoseconds or less.

60. Check Vertical Amplifier Risetime—Left

a. Requirement—Risetime of the 10% to 90% portion of the rising portion should be 6.93 nanoseconds or less with the test load unit pulse risetime of 3 nanoseconds.

b. Change the A Triggering SOURCE switch to LEFT INT NORM.

c. Change the Upper Beam DISPLAY to LEFT PLUG-IN A.

d. With the left test load unit Vertical Position and Upper Beam POSITION controls, position the 5-cm display so that the 10% point on the rising portion of the waveform is at the same point as in step 59 (c).

e. Check—Risetime of the 10% to 90% portion of the pulse rise should be 6.93 nanoseconds or less.

61. Check Vertical Amplifier Risetime—Right

a. Requirement—Risetime of the 10% to 90% portion of the rising portion should be 6.93 nanoseconds or less with the test load unit pulse risetime of 3 nanoseconds.

b. Check that the B TIME/CM switch is set to .1 μSEC.

c. Set the Lower Beam DISPLAY MAG switch to ×10.

d. Rotate the left plug-in unit Vertical Position control so that the Upper Beam display is below the viewing area, and increase the Lower Beam INTENSITY so that the Lower Beam display is visible.

e. Position the 5-cm Lower Beam display so that the 10% point on the rising portion crosses the intersection of the 1-cm horizontal graticule line and the graticule center vertical line. See Fig. 5-14 for correct display positioning.

f. Check—Risetime of the 10% to 90% portion of the rising portion should be 6.93 nanoseconds or less with the test load unit pulse risetime of 3 nanoseconds. Fig. 5-14 shows a typical display.

SECTION 6
CALIBRATION

Change information, if any, affecting this section is found at the rear of the manual.

Introduction

This calibration procedure can be used either for complete calibration of the Type 556 to return it to original performance, or as an operational check of the instrument performance. Completion of every step in this procedure will return the Type 556 to its original standards. If a complete calibration of the instrument is not desired, refer to the "Calibration Index" for the page location of individual step instruction.

General Information

The calibration of the Type 556 should be checked at regular intervals to insure that it is operating properly and accurately. (See the Maintenance section of this manual for the recommended recalibration interval.) In addition, certain portions of the instrument must be recalibrated after tubes or transistors have been changed or repairs have been made. A complete procedure is provided in this section for checking the calibration of the Type 556, and for making adjustments when necessary.

In the instructions that follow, the steps are arranged in convenient sequence to avoid unnecessary repetition. If a complete recalibration is not needed, individual steps may be performed separately only if those steps do not affect any other adjustments.

Important information and preliminary settings of controls are given at the beginning of the calibration procedure. Any controls that are not mentioned are not critical during that portion of the procedure. Test equipment used in a particular step should remain connected at the end of the step unless instructions state otherwise. If only part of the procedure is being performed, it may be necessary to check back to the last major setup change to determine the test equipment connections and setting of controls.

Internal controls should not be preset unless the instrument has been repaired or is known to be seriously out of adjustment. If repairs have been made, preset internal controls to mid-range in the affected circuits.

NOTE

Certain adjustments is some circuits interact with adjustments in other circuits in the instrument. Refer to the schematic diagrams; if in doubt about the effect of an adjustment on other circuits, check the calibration of all closely associated circuits.

If adjustments are made on the power supplies, the calibration of the entire instrument should be checked. In particular, the sweep rates and vertical deflection factors will be affected.

RECOMMENDED EQUIPMENT (see Figs. 6-1 through 6-3)

General

The following equipment or its equivalent is recommended for complete calibration of the Type 556. Specifications given are the minimum necessary for accurate calibration of this instrument. All test equipment is assumed to be correctly calibrated and operating within the orginal specifications. If equipment is substituted, it must meet or exceed the specifications of the recommended equipment.

Special Test Equipment

For the quickest and most accurate calibration, special calibration fixtures are used where necessary. All calibration fixtures listed under "Recommended Equipment" can be obtained from Tektronix, Inc. Order by part number through your local Tektronix Field Office or representative.

1. Test oscilloscope. Bandwidth, DC to 10 MHz; minimum deflection factor, 0.005 volts/division; 1× and 10× probes. Tektronix Type 531A Oscilloscope recommended, with Type W plug-in.

2. 10× probe with BNC connector. Tektronix Type P6006 recommended. Part No. 010-0128-00.

3. 1× probe with BNC connector. Tektronix Type P6028 recommended. Part No. 010-0120-00.

4. Time-mark generator. Marker outputs, 5 seconds to 0.1 microsecond; sine-wave output at 50 MHz. Tektronix Type 184 recommended.

5. Constant-amplitude sine-wave generator. Frequencies, 50 kHz and 350 kHz up to ≥50 MHz; output amplitude, at least 1 volt; amplitude accuracy, ±5% into 50 Ω load. Tektronix Type 191 recommended.

6. Test load and pulser unit. Tektronix Calibration Fixture, Part No. 067-0521-00 (2 required).

7. Precision DC voltmeter. Accuracy, within ±0.05%; meter resolution 50 μV; range, 0.1 to 500 volts. For example, Fluke Model 801B.

8. Amplitude calibrator. Amplitude accuracy, within 0.25%; signal amplitude, 0.1 volts to 100 volts; output signal, 1 kHz square-wave and +DC; must have mixed display feature. Tektronix Calibration Fixture 067-0502-00 recommended.

9. DC voltmeter. Minimum sensitivity, 20,000 Ω/volt; accuracy checked to within 1% at —1850 volts. For example, Simpson Model 262.

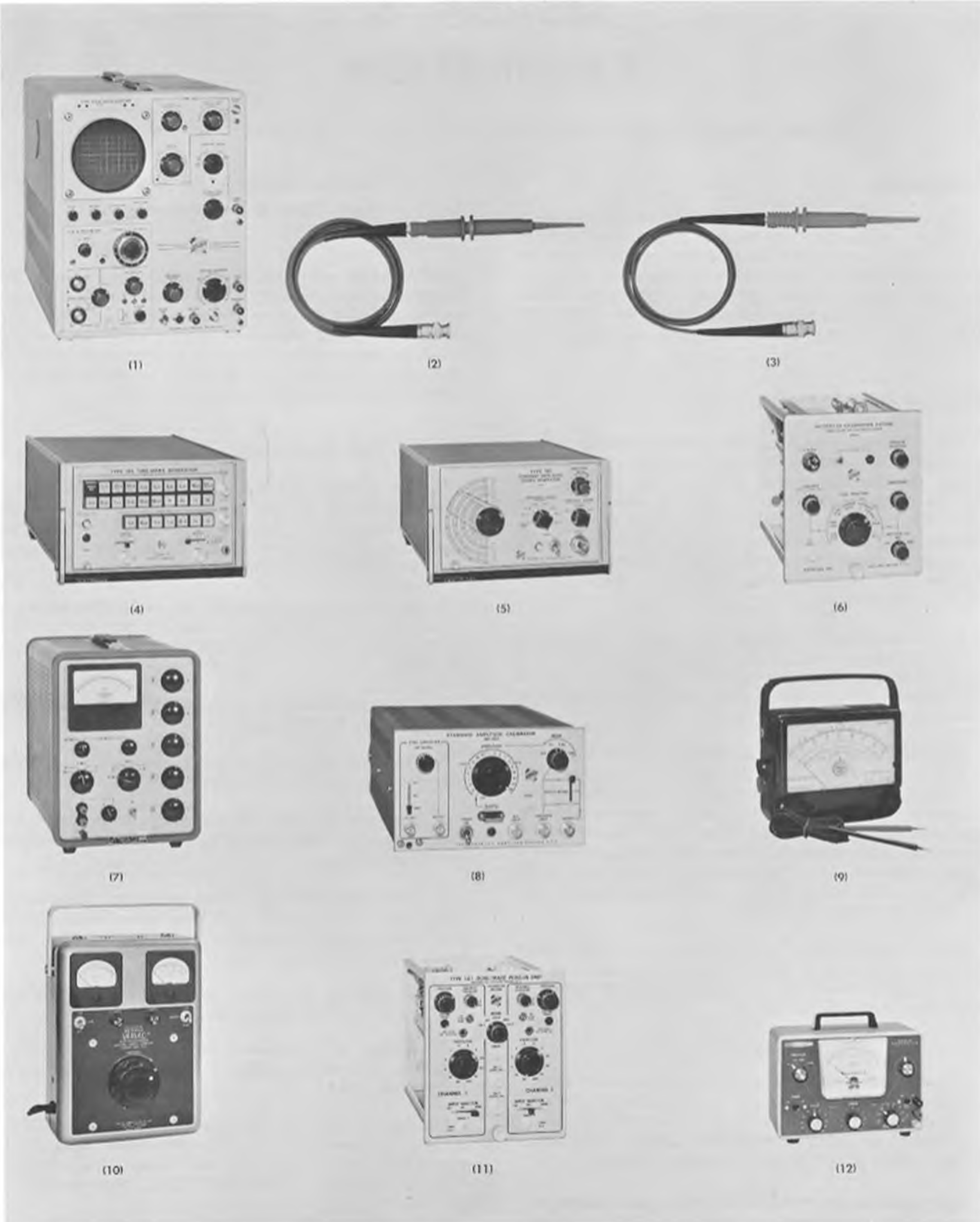


Fig. 6-1. Recommended calibration equipment. Items 1 through 12.

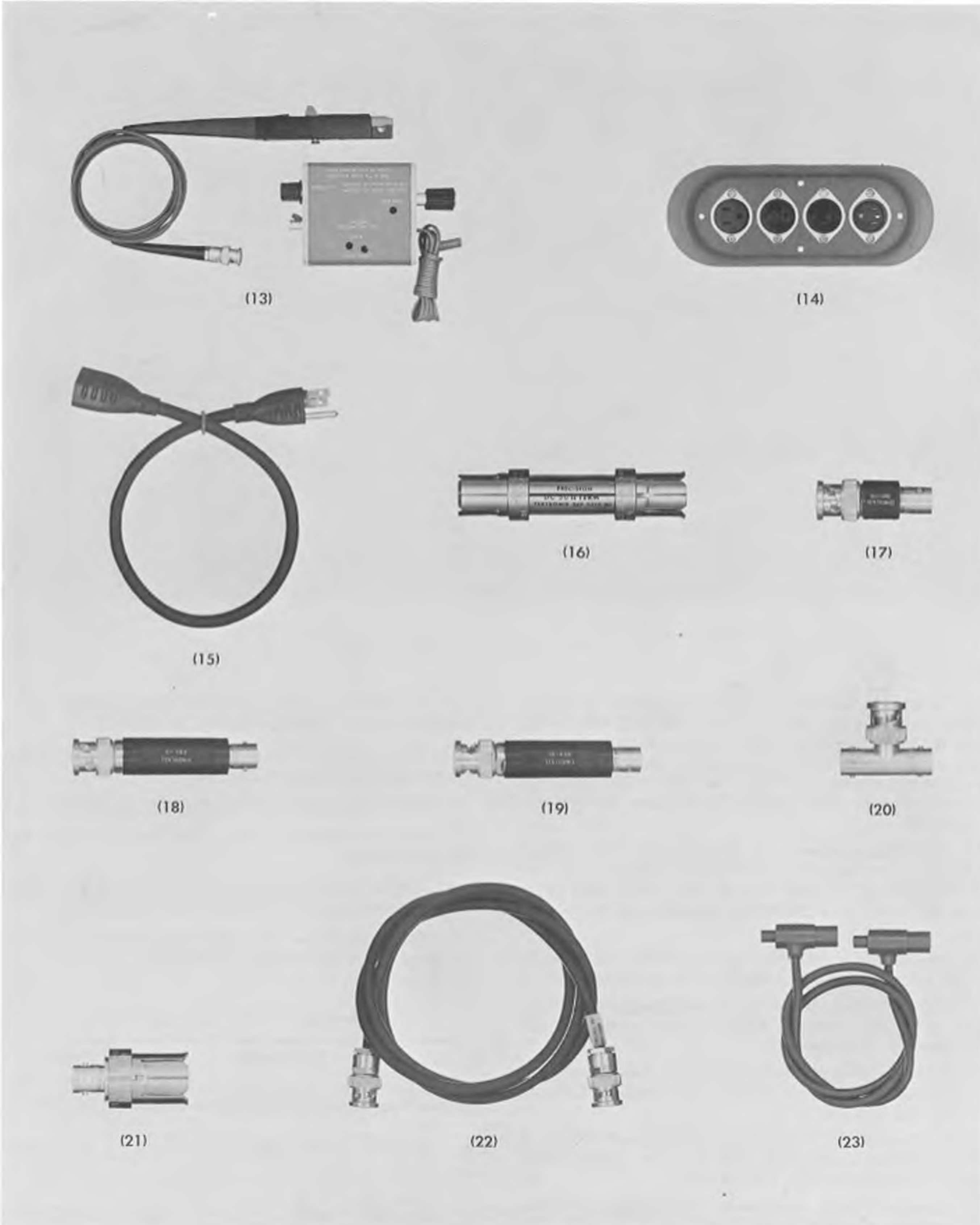


Fig. 6-2. Recommended calibration equipment. Items 13 through 23.

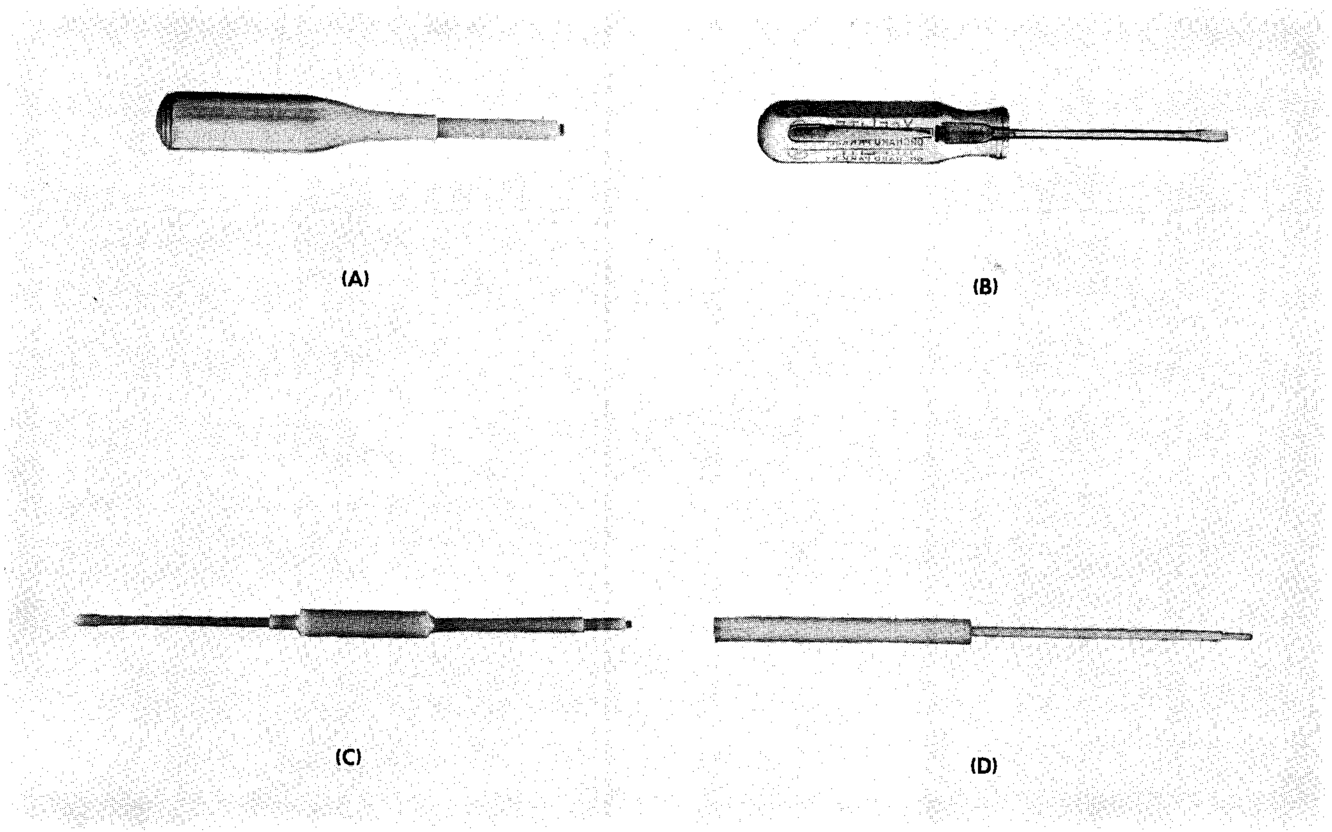


Fig. 6-3. Adjustment tools.

10. Variable autotransformer. Must be capable of supply-1 kVA over a voltage range of 90 to 130 VAC (182 to 260 volts for 230-volt nominal line). If autotransformer does not have an AC voltmeter (RMS), monitor the output with a voltmeter having a range of at least 130 volts (or 260 volts). For example, General Radio W10MT3W Metered Variac Autotransformer.

11. Plug-in preamplifiers with dual channel inputs, vertical deflection sensitivity to 5 millivolts/cm. Tektronix Type 1A1 or equivalent, 2 required. Include one 18-inch 50 Ω cable (Tektronix Part No. 012-0076-00) supplied with the plug-in unit.

12. Low-frequency sine-wave signal generator, 30 Hz to 60 kHz, 1 volt output, Heathkit Model 1G-72 or equivalent.

13. Current probe. Sensitivity, 1 milliamp/division; accuracy, within 3%. Tektronix P6019 Current Probe with Type 134 Amplifier recommended.

14. 3-wire socket assembly (required only if autotransformer is equipped with a single output power socket). Tektronix Part No. 136-0102-00.

15. 3-wire power cable 20 inches long (required only if autotransformer is equipped with a single output power socket). Tektronix Part No. 161-0014-00.

16. Precision 50-ohm termination. For example, Tektronix Calibration Fixture Part No. 067-0515-00.

17. Termination (two). Impedance, 50 ohm; accuracy, $\pm 3\%$; connectors, BNC. Tektronix Part No. 011-0049-00.

18[1]. 5× attenuator. Impedance, 50 ohm; accuracy, $\pm 3\%$; connectors, BNC. Tektronix Part No. 011-0060-00.

19[1]. 10× attenuator. Impedance, 50 ohm; accuracy, $\pm 3\%$; connectors, BNC. Tektronix Part No. 011-0059-00.

20. BNC T connector. Tektronix Part No. 103-0030-00.

21. Adapter. Connectors, GR to BNC jack. Tektronix Part No. 017-0063-00.

22. Cable (four). Impedance, 50 Ω; type, RG58A/U; length, 42 inch; connectors, BNC. Tektronix Part No. 012-0057-00.

23. Patch cord, 18 inch with BNC plug-in jack terminals on each end. Tektronix Part No. 012-0087-00.

Adjustment tools (see Fig. 6-3)

Description	Tektronix Part No.
a. Insulated screwdriver ($1\frac{1}{2}$ inch shaft, non-metallic	003-0000-00
b. Screwdriver, 3 inch shaft	003-0192-00
c. Tuning rod, 5 inch	003-0301-00
d. Tuning tool	
Handle	003-0307-00
Insert, for $\frac{5}{64}$ inch (ID) hex cores	003-0310-00

[1]Items 18 and 19 are needed if a generator does not have an output amplitude control.

CALIBRATION RECORD AND INDEX

This Abridged Calibration Procedure is provided to aid in checking the operation of the Type 556. It may be used as a calibration guide by the experienced calibrator, or it may be used as a calibration record. Since the step numbers and titles used here correspond to those used in the complete Calibration Procedure, the following procedure serves as an index to locate a step in the complete Calibration Procedure. Characteristics are those listed in the Characteristics section of the Instruction Manual.

Type 556, Serial No. ______________

Calibration Date ______________

☐ 1. Adjust Power Supply (Page 6-9)
Adjust −150 V, ±1.5 V
Adjust +100 V, ±1 V
Adjust +225 V, ±0.625 V (measured between +100 V and +225 V)
Check +350 V, ±10.5 V

☐ 2. Check Power Supply Ripple and Regulation (page 6-10)

Low Load at High Line

	Maximum Ripple (Peak-to-Peak)
−150 V	5 mV
+100 V	5 mV
+225 V	10 mV
+350 V	15 mV

☐ 3. Check Power Supply Ripple and Regulation (page 6-12)

High Load at Low Line

	Maximum Ripple (Peak-to-Peak)
−150 V	5 mV
+100 V	5 mV
+225 V	10 mV
+350 V	15 mV

☐ 4. Adjust High Voltage—Lower Beam (page 6-12)
Adjust −1850 V, ±55 V.

☐ 5. Adjust High Voltage—Upper Beam (page 6-12)
Adjust −1850 V, ±55 V.

☐ 6. Adjust Amplitude Calibrator (page 6-14)
Voltage accuracy, ±2%.

☐ 7. Check Terminated Voltage (page 6-15)
Accuracy, ½ indicated V ±2% when terminated in 50 Ω.

☐ 8. Check Repetition Rate (page 6-15)
Rate 1 kHz ±25%.

☐ 9. Check Duty Cycle (page 6-15)
Duty cycle, 45 to 55%.

☐ 10. Check Risetime (page 6-16)
Risetime, ≤1.5 microseconds.

☐ 11. Check 5 mA Current Loop (page 6-16)
5 mA through probe loop.

☐ 12. Check Horizontal Deflection/Graticule Alignment (page 6-16)
Trace parallel to horizontal graticule lines.

☐ 13. Check Beam Finder Switch Operation (page 6-17)
Over-scanned display returned to viewing area.

☐ 14. Adjust Geometry (page 6-18)
Best overall geometry.

☐ 15. Adjust Focus and Astigmatism (page 6-19)
Sharp, well-defined displays.

☐ 16. Check Upper and Lower Beam Scan Areas (page 6-19)
≥6 cm × 10 cm per beam, except for graticule corners.

☐ 17. Check CRT Orthogonality (page 6-20)
90° ±1°.

☐ 18. Adjust Vertical Amplifier DC Balance—Left (page 6-20)
Trace centering with balance control.

☐ 19. Adjust Vertical Amplifier DC Balance—Right (page 6-21)
Trace centering with balance control.

☐ 20. Check Trace Separation Range (page 6-21)
Trace superimposition within the center 4-cm area of the graticule.

☐ 21. Adjust Vertical Amplifier Gain (page 6-22)
Correct vertical deflection.

☐ 22. Check Vertical Amplifier Compression/Expansion (page 6-23)
≤0.5 mm compression/expansion with 2 cm signal.

☐ 23. Check Common Mode Rejection (page 6-23)
Display amplitude ≤3 mm with common-mode input of 1 volt to test load unit.

☐ 24. Check Trace Drift with Line Voltage Change (page 6-24)
≤ ±2 mm within line voltage change limits.

☐ 25. Check Alternate-trace Operation (page 6-26)
Trace alternation at all sweep rates.

☐ 26. Check Multi-trace Chopping Transient Blanking (page 6-26)
Blanking of switching transients in the chopped mode.

☐ 27. Adjust External Triggering—A and B Sweeps (page 6-27)
Correct trigger operation; see Calibration Procedure.

☐ 28. Check B Triggering Level Control Ranges (page 6-28)
Normal, ≥ ±2 V; ×10 range increase, ≥ ±20 V.

☐ 29. Check A Triggering Level Control Ranges (page 6-29)
Normal, ≥ ±2 V; ×10 range increase, ≥ ±20 V.

☐ 30. Check Internal Triggering—Lower Beam (page 6-30)
Correct triggering with minimum deflections.

- ☐ 31. Check Internal Triggering—Upper Beam (page 6-31)
  Correct triggering with minimum deflections.
- ☐ 32. Check Crossover Triggering (page 6-31)
  Correct triggering with minimum deflections.
- ☐ 33. Check Auto Stability Operation (page 6-32)
  Sweep triggering at 30 Hz.
  Sweep free-runs with no signal.
- ☐ 34. Check Line Trigger and LF Reject Operation (page 6-32)
  Triggering at line frequency; no triggering at low frequencies.
- ☐ 35. Check A and B Single Sweep Operation (page 6-32)
  Sweeps trigger with same trigger level as in AUTO STABILITY; sweeps lock out until reset.
- ☐ 36. Adjust Basic Timing—A Sweep (page 6-33)
  Sweep timing within ±3% of indicated sweep rate at ×1 and ±5% at ×10.
- ☐ 37. Adjust Upper Beam Sweep Magnifier Registration (page 6-34)
  ≤0.5 cm shift when switching from magnified to normal sweep.
- ☐ 38. Adjust A Sweep Sawtooth Amplitude (pages 6-34)
  Sweep length 10.5 cm ±0.5 cm at 1 millisecond/cm.
- ☐ 39. Adjust B Sweep Sawtooth Slope (page 6-34)
  Timing adjustment to match the B sweep generator to the A sweep generator.
- ☐ 40. Adjust B Sweep Sawtooth Amplitude (page 6-35)
  Sweep length 10.5 cm ±0.5 cm at 1 millisecond/cm.
- ☐ 41. Adjust Basic Timing—B Sweep (page 6-35)
  Sweep timing within ±3% of indicated sweep rate at ×1 and ±5% at ×10.
- ☐ 42. Adjust Lower Beam Sweep Magnifier Registration (page 6-35)
  ≤0.5 cm shift when switching from magnified to normal sweep.
- ☐ 43. Adjust Lower Beam A Sweep Gain (page 6-36)
  Sweep timing within ±5% of indicated sweep rate. This step is not applicable to 556 instruments with serial numbers 100 to 1999.
- ☐ 44. Adjust A and B Sawtooth Currents (page 6-36)
  Sawtooth current waveforms at plug-in unit connectors, pin 6.
- ☐ 45. Check Delay-Time Multiplier Dial Setting (page 6-37)
  Counterclockwise setting, 00.20, ±2 minor divisions; clockwise setting, 10.20, ±4 minor divisions.
- ☐ 46. Adjust Delay Start and Stop (page 6-38)
  Correct adjustment, ±8 minor divisions.
- ☐ 47. Check Delay-Time Multiplier Incremental Linearity (page 6-39)
  ±2 minor divisions from 1.00 to 9.00 major dial divisions.
- ☐ 48. Check Delay-Time Jitter (page 6-39)
  Jitter ≤0.5 cm.
- ☐ 49. Adjust Timing—A Sweep (page 6-40)
  Sweep timing within ±3% of indicated sweep rate.
- ☐ 50. Adjust Horizontal Amplifier 50 MHz compensations—Upper Beam (page 6-42)
  Timing accuracy ±5% (or ±4 mm) 4 cm from sweep start to 70 cm from sweep start.
- ☐ 51. Check Timing and Delaying Sweep Accuracy—A Sweep (page 6-43)
  A Sweep accuracy, ±3% or 2.4 mm; delaying sweep, within 8 minor divisions of the DELAY-TIME MULTIPLIER dial for each position of the A TIME/CM switch.
- ☐ 52. Adjust Timing—B Sweep (page 6-44)
  Sweep timing within ±3% of indicated sweep rate.
- ☐ 53. Adjust C882—B Sweep Crossover Compensation (page 6-44)
  Timing accuracy, ±3%, Upper Beam display.
- ☐ 54. Adjust Horizontal Amplifier 50 MHz Compensation—Lower Beam (page 6-45)
  Timing Accuracy ±5% (or ±4 mm) 4 cm from sweep start to 70 cm from sweep start.
- ☐ 55. A Sweep Crossover Compensation (page 6-46)
  Tolerance, ±3% or ±2.4 mm.
  This step is not applicable to 556 instruments with serial numbers 100 to 1999.
- ☐ 56. Check Timing Accuracy—B Sweep (page 6-46)
  Timing accuracy within ±3% of indicated sweep rate.
- ☐ 57. Check Variable Time/cm Range (page 6-46)
  ≥2.5:1 reduction in A and B Sweep rates.
- ☐ 58. Check Trigger Delay (page 6-46)
  Trigger delay ≤150 nanoseconds.
- ☐ 59. Adjust External Horizontal Amplifier DC Balance—Upper Beam (page 6-47)
  ≤ ±5 cm horizontal shift of the left edge of the display as the UPPER BEAM EXT HORIZ VAR 1-10 control is rotated.
- ☐ 60. Check External Horizontal Amplifier Variable Control Range—Upper Beam (page 6-48)
  ≥10:1 ratio of horizontal deflection control.
- ☐ 61. Adjust External Horizontal Amplifier ×10 Compensation—Upper Beam (page 6-49)
  ≤3% overshoot, rolloff, or ringing.
- ☐ 62. Adjust External Horizontal Amplifier ×1 Compensation—Upper Beam (page 6-49)
  ≤3% overshoot, rolloff, or ringing.
- ☐ 63. Check Magnifier ×-1×10 Ratio Accuracy—Upper Beam (page 6-49)
  Ratio of 10:1, within 3%.

☐ 64. Adjust External Horizontal Amplifier DC Balance—Lower Beam (page 6-49)
$\leq$5 cm horizontal shift of the left edge of the display as the LOWER BEAM EXT HORIZ VAR 1-10 control is rotated.

☐ 65. Check External Horizontal Amplifier Variable Control Range—Lower Beam (page 6-50)
$\geq$10:1 ratio of horizontal deflection control.

☐ 66. Adjust External Horizontal Amplifier ×1 and ×10 Compensations—Lower Beam (page 6-50)
$\leq$3% overshoot, rolloff, or ringing.

☐ 67. Check Magnifier ×1-×10 Ratio Accuracy—Lower Beam (page 6-50)
Ratio of 10:1, within 3%.

☐ 68. Check Z Axis Operation—Upper and Lower Beams (page 6-50)
Intensity modulation with 10-volt signal.

☐ 69. Check A Sweep Sawtooth Amplitude (page 6-50)
$\geq$94.5 V for a 10.5 cm A sweep.

☐ 70. Check B Sweep Sawtooth Amplitude (page 6-52)
$\geq$94.5 V for a 10.5 cm B sweep.

☐ 71. Check A Sweep Gate Amplitude (page 6-52)
Waveform amplitude $\geq$10 V.

☐ 72. Check B Sweep Gate Amplitude (page 6-52)
Waveform amplitude $\geq$10 V.

☐ 73. Check Delayed Trigger Waveform Amplitude (page 6-52)
Pulse amplitude $\geq$7 V.

☐ 74. Adjust 8608 Bias Control (page 6-52)
Front corner waveform change $\leq$2.25% overshoot, rolloff, or ringing.

☐ 75. Adjust Vertical Amplifier High Frequency Compensations—Left (page 6-53)
$\leq$2.25% overshoot, rolloff, or ringing.

☐ 76. Adjust Vertical Amplifier High Frequency Compensations—Crossover (page 6-55)
$\leq$2.25% overshoot, rolloff, or ringing.

☐ 77. Adjust Vertical Amplifer High Frequency Compensations—Right (page 6-55)
$\leq$2.25% overshoot, rolloff, or ringing.

☐ 78. Check Vertical Amplifier Risetime—Right (page 6-56)
$\leq$6.93 nanoseconds with test load unit.

☐ 79. Check Vertical Amplifier Risetime—Crossover (page 6-56)
$\leq$6.93 nanoseconds with test load unit.

☐ 80. Check Vertical Amplifier Risetime—Left (page 6-56)
$\leq$6.93 nanoseconds with test load unit.

☐ 81. Check High Frequency Triggering (page 6-57)
Stable displays with 50 MHz signals.

CALIBRATION PROCEDURE

General

In the following calibration procedure, a test equipment setup is shown for each major setup change. Complete control settings are listed following the picture. To aid in locating individual controls which have been changed during a major calibration step, these controls are listed at the beginning of the step. If only a partial calibration is performed, start with the nearest major setup preceding the desired portion.

NOTE

When performing a complete recalibration best performance will be obtained if each adjustment is made to the exact setting, even if the Check is within the allowable tolerance.

The following procedure uses the equipment listed under "Recommended Equipment". If substitute equipment is used, control settings or setup must be altered to meet the requirements of the equipment used.

Preliminary Procedure

1. Remove the side, bottom, and top covers from the Type 556.

2. Connect the autotransformer (if used) to a suitable power source.

3. Connect the Type 556 power cord to the autotransformer output (or directly to the power source).

4. Install two test load units in the Type 556.

5. Preset the Type 556 and test load unit controls as follows:

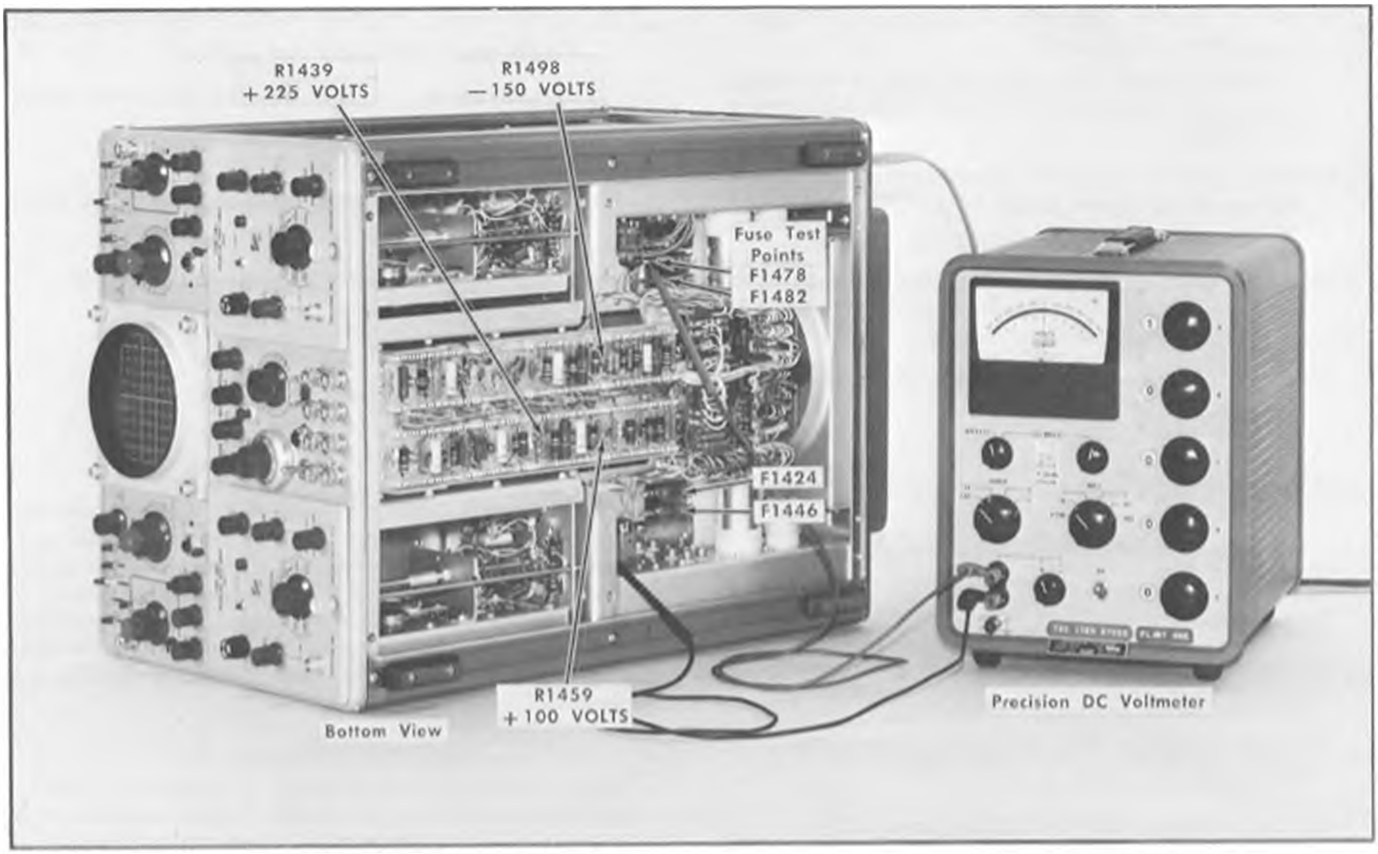


Fig. 6-4. Initial test setup for power supply voltage adjustment.

Type 556

A Triggering Controls

SOURCE	NORM INT, LEFT
COUPLING	AC
SLOPE	+
MODE	TRIG
LEVEL	Clockwise, knob pushed in

Upper Beam Controls

DISPLAY	LEFT PLUG-IN A
POSITION	Mid-range
DISPLAY MAG	×1
INTENSITY	0
FOCUS	0
ASTIGMATISM	0
CONTRAST	Clockwise
UPPER BEAM EXT HORIZ VAR 1-10	Clockwise

A Sweep Controls

A TIME/CM	.5 mSEC
VARIABLE	CALIBRATED
A MODE	NORM

B Triggering Controls

SOURCE	NORM INT, RIGHT
COUPLING	AC
SLOPE	+
MODE	TRIG
LEVEL	Clockwise, knob pushed in

Lower Beam Controls

DISPLAY	RIGHT PLUG-IN B
POSITION	Mid-range
DISPLAY MAG	×1
INTENSITY	0
FOCUS	0
ASTIGMATISM	0
CONTRAST	Clockwise
LOWER BEAM EXT HORIZ VAR 1-10	Clockwise

B Sweep Controls

B TIME/CM	.5 mSEC
VARIABLE	CALIBRATED
B MODE	NORM
SCALE ILLUMINATION	0
TRACE SEPARATION	Mid-range
DELAY-TIME MULTIPLIER	1.00
AMPLITUDE CALIBRATOR	OFF
POWER	Off

Rear Panel Controls

Upper Beam CRT Cathode Selector	EXT CRT CATHODE
Lower Beam CRT Cathode Selector	EXT CRT CATHODE

Test Load Vertical Plug-In Units (both units)

Test Function	Low Load
Variable	Mid-range
Amplitude	Mid-range
Vertical Position	Mid-range
Repetition Rate	Low

6. Set the autotransformer for 115 VAC, turn the POWER switch to ON and allow 20 minutes for instrument warmup.

1. Adjust Power Supply Voltages ⓿

a. The initial test equipment setup is shown in Fig. 6-4.

b. Set the precision DC voltmeter (item 7 of Recommended Equipment) to the —150 volt range.

c. Connect the voltmeter negative lead to the output end of fuse F1482 (Fig. 6-4), and connect the positive lead to chassis ground.

d. Check—A reading of —150 volts, ±1.5 volts.

e. Adjust R1498 (Fig. 6-4) for a reading of —150 volts.

f. Set the voltmeter to the 100-volt range. Connect the positive meter lead to fuse F1478 (Fig. 6-4), and connect the negative lead to chassis ground.

g. Check—A reading of +100 volts, ±1.00 volt.

h. Adjust R1459 (Fig. 6-4) for a reading of +100 volts.

i. Set the voltmeter to the +125 volt range.

j. Connect the negative meter lead to the +100-volt fuse F1478, and connect the positive meter lead to the +225-volt fuse F1446 (Fig. 6-4).

k. Check—A reading of +125 volts, ±0.625 volts.

l. Adjust R1439 (Fig. 6-4) for a meter reading of +125 volts.

m. Set the meter to the +350-volt range, and connect the positive meter lead to fuse F1424 (Fig. 6-4).

n. Connect the negative meter lead to the oscilloscope chassis ground.

o. Check—A meter reading of +350 volts, ±10.5 volts.

p. Disconnect the meter leads.

NOTES

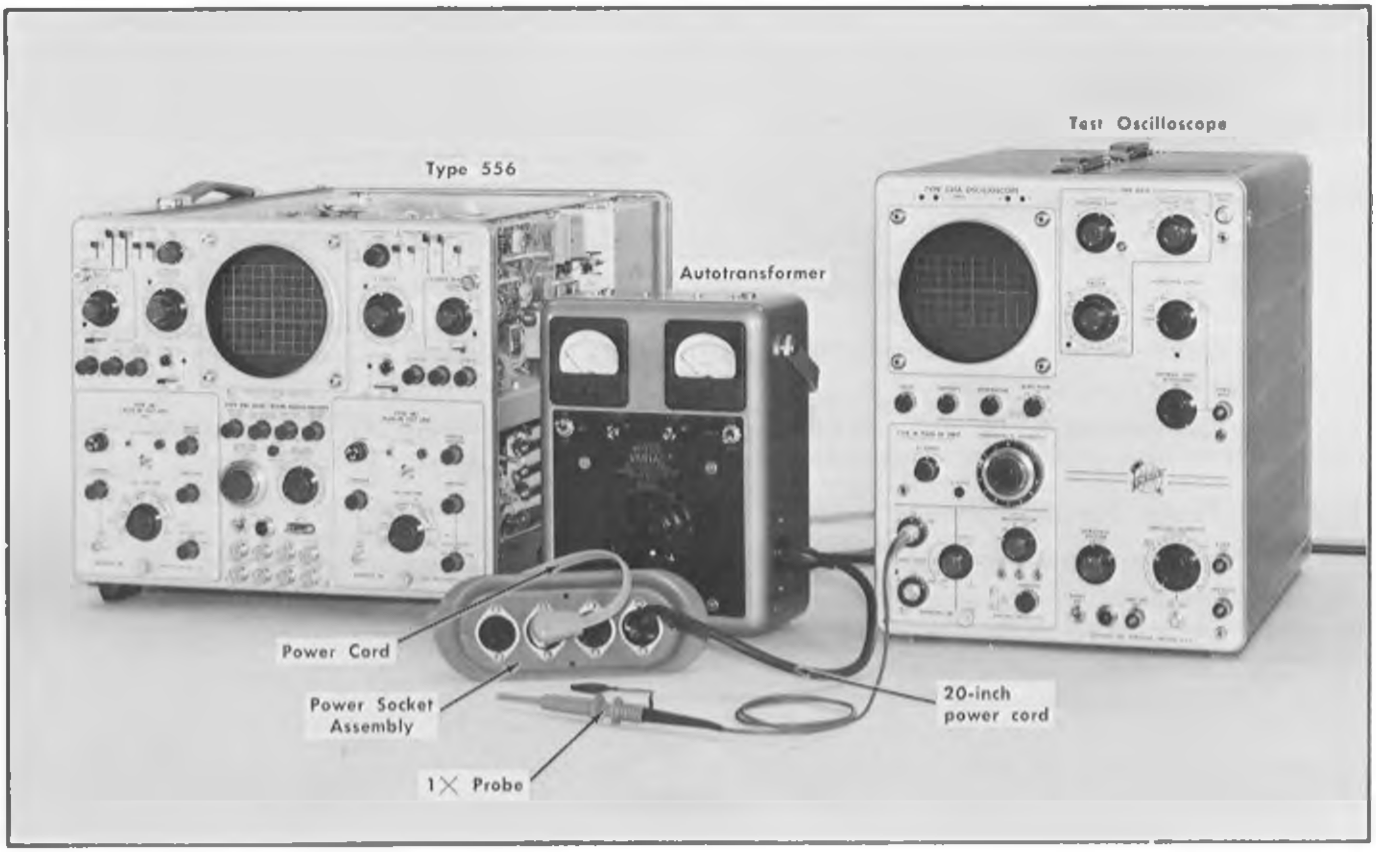


Fig. 6-5. Initial test setup for checking power supply ripple and regulation.

2. Check Power Supply Ripple and Regulation—Low Load at High Line Voltage

NOTE

The following procedure applies only to a Type 556 connected to a nominal 115-volt 3-wire power source. For an instrument connected to other than a nominal 115-volt source, a procedure and test fixtures adapted to local conditions will be required; for example, a 230-volt source will require an autotransformer with the higher output, an isolation transformer for the test oscilloscope, power sockets, etc.

a. The initial test setup is shown in Fig. 6-5. Type 556 controls remain as in Step 1; other control settings are as follows:

Test Load Unit (both)	
Test Function	Low Load
Test Oscilloscope	
Time/cm	5 milliseconds
Type W	
AC-DC-GND (A)	DC
AC-DC-GND (B)	GND
Input Atten	100
Millivolts/cm	50
Display	A-Vc
Vc Range	0
Autotransformer	134 (RMS)

b. Connect the 20-inch power cord between the autotransformer and the power socket assembly, and connect the Type 556 power cord to the power socket asembly, as shown in Fig. 6-5.

NOTE

The short power cord and the socket assembly (items 14 and 15 of Recommended Equipment) are used only to provide convenient measurement terminals with a minimum of hazard. If the autotransformer used is equipped with more than one output socket, the cord and socket assembly may be eliminated.

c. Connect a 1× probe to the test oscilloscope input connector.

d. Connect the probe ground lead to the ground pin of one of the sockets in the power socket assembly.

e. With the probe tip, determine which of the two remaining socket contacts is the neutral contact, and connect the probe tip to this socket contact.

f. Change the Type W Millivolts/cm switch to 20. The vertical deflection sensitivity should now be 2 volts/cm.

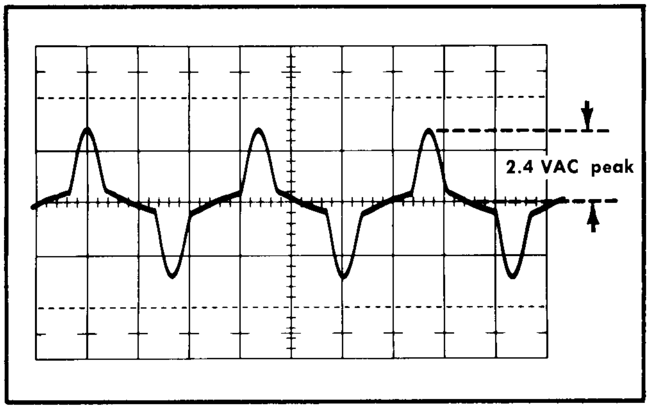


Fig. 6-6. Illustrating measurement of voltage drop in neutral wire. Probe connected between grounding pin and neutral wire; Type W Time/cm, 5 milliseconds; vertical sensitivity, 2 volts/cm.

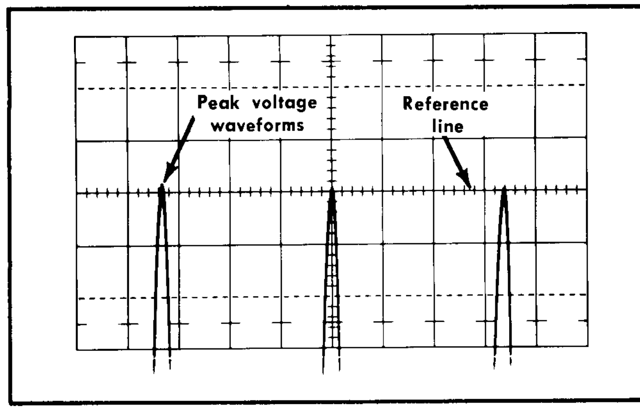


Fig. 6-7. Illustrating method of peak line voltage measurement; Type W plug-in vertical deflection factor 1 V/cm; sweep rate 5 milliseconds/cm.

g. Measure the peak voltage of the waveform, as shown in Fig. 6-6.

h. Set the Type W Comparison Voltage (Vc) dial to 178 plus the voltage reading obtained in step (g).

Example: If the reading obtained in step (g) was 2.4 volts, the dial should be set to 180.4.

i. Set the Vc Range to +11.

j. Change the Millivolt/cm switch to 10.

k. Move the probe tip from the neutral contact to the high-voltage or "hot" contact in the power socket assembly.

l. Adjust the autotransformer output until the tips of the waveforms shown on the test oscilloscope reach the reference line established previously by the Type W. (See Fig. 6-7 for typical display). The test oscilloscope is now indicating 178 peak VAC at the autotransformer output, or 126 volts RMS (RMS × 1.414 = Peak).

m. Change the Vc Range to 0, and the AC-DC-GND switch to AC.

n. Remove the probe tip and ground lead from the power socket contacts, connect the probe tip to the Type 556 +100-volt fuse (output end), and connect the probe ground lead to the chassis ground.

CAUTION

When the Type W is used with the AC-DC-GND switch in the AC coupling position, the Input Atten switch must be set (steps q, t, and w that follow) so that input voltages applied internally to the W unit amplifier are attenuated to 15 volts or less until the input coupling capacitor is charged. Failure to observe this precaution when connecting the probe to the Type 556 power supply fuses may result in damage to Type W components.

o. Change the Input Atten switch to 1, and the Millivolts/cm to 5.

p. Check—Ripple amplitude not to exceed 5 millivolts/cm (See Table 6-1).

TABLE 6-1

Power Supply Ripple Tolerances

Power Supply	Ripple (Peak-to-Peak)
—150	5 millivolts
+100	5 millivolts
+225	10 millivolts
+350	15 millivolts

q. Remove the probe tip, and change the Input Atten to 100.

r. Connect the probe to the —150-volt fuse, and change the Input Atten to 1.

s. Check—Ripple amplitude not more than 5 millivolts.

t. Remove the probe tip, and change the Input Atten to 100.

u. Connect the probe to the +225-volt fuse, and change the Input Atten to 1.

v. Check—Ripple amplitude not more than 10 millivolts.

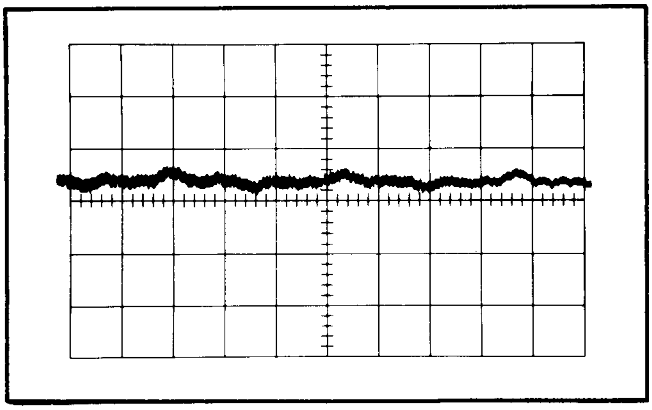


Fig. 6-8. Typical test oscilloscope display of power supply ripple, —150 volt supply (60 cycle line). Vertical deflection, 0.005 volts/cm; sweep rate, 5 milliseconds/cm; low load condition.

w. Remove the probe, and change the Input Atten to 100.

x. Connect the probe to the +350-volt fuse, and change the Input Atten to 1.

y. Check—Ripple amplitude not more than 15 millivolts.

z. Disconnect the probe and ground lead from the Type 556.

NOTE

With the Type 556 power supply regulation circuits operating normally, the DC regulated voltages will not deviate from the specified tolerances when the line voltage is varied between the lower and upper voltage limits. This is due to the use of transistors in the regulating circuits; therefore a check of the ripple amplitudes present will be an accurate check of the limits of regulation. For this reason the normal monitoring of the DC voltages has been omitted from the procedure.

3. Check Power Supply Ripple and Regulation—High Load at Low Line Voltage

a. Change Input-A AC-DC-GND to DC, the Input Atten to 100, and the Millivolts/cm to 20.

b. Change both test load unit Test Function switches to High Load and set the AMPLITUDE CALIBRATOR switch to 100 V DC.

c. Set the autotransformer output to approximately 100 volts, as shown on the RMS meter.

d. Repeat steps 2 (d), (e), and (g).

e. Set the Comparison Voltage (Vc) dial to 141.1 plus the reading obtained in step (g).

Example: If the peak reading obtained in step (g) was 3.0 volts, set the dial to 144.4.

f. Repeat steps 2 (i), (j), and (k).

g. Adjust the autotransformer output until the tips of the waveforms shown on the test oscilloscope reach the reference line established previously by the Type W. The test oscilloscope is now indicating 141.4 volts peak AC at the autotransformer output, or 100 volts RMS.

h. Repeat steps 2 (m) through (z).

i. Return the autotransformer output to 115 volts.

4. Adjust High Voltage—Lower Beam ⓘ

a. Set the DC voltmeter (item 9 of Recommended Equipment) to the high voltage range.

b. Connect the meter leads from the high voltage test point to chassis ground, as shown in Fig. 6-10.

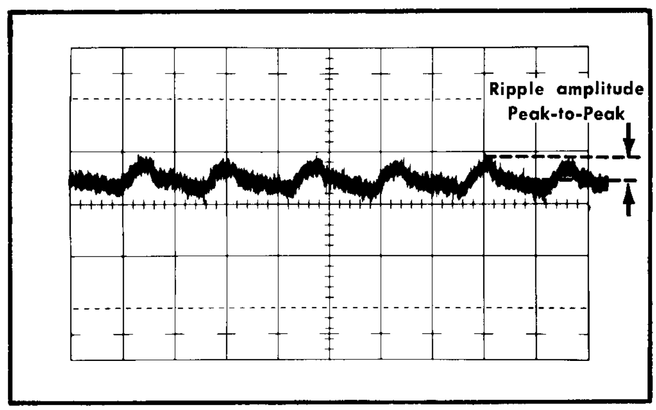


Fig. 6-9. Typical display showing ripple on +350-volt supply (60 cycle line). Vertical deflection, 0.005 volts/cm; sweep rate, 5 milliseconds/cm; high load condition.

c. Check—A meter reading of —1850 volts ±55 volts.

d. Adjust High Voltage control R1332 for a meter reading of —1850 volts. Fig. 6-10 shows the control location.

5. Adjust High Voltage—Upper Beam ⓘ

a. Connect the meter leads from the high voltage test point to chassis ground, as shown in Fig. 6-11.

b. Check—A meter reading of —1850 volts, ±55 volts.

c. Adjust High Voltage control R1382 for a meter reading of —1850 volts. Fig. 6-11 shows the control location.

d. Remove the meter leads.

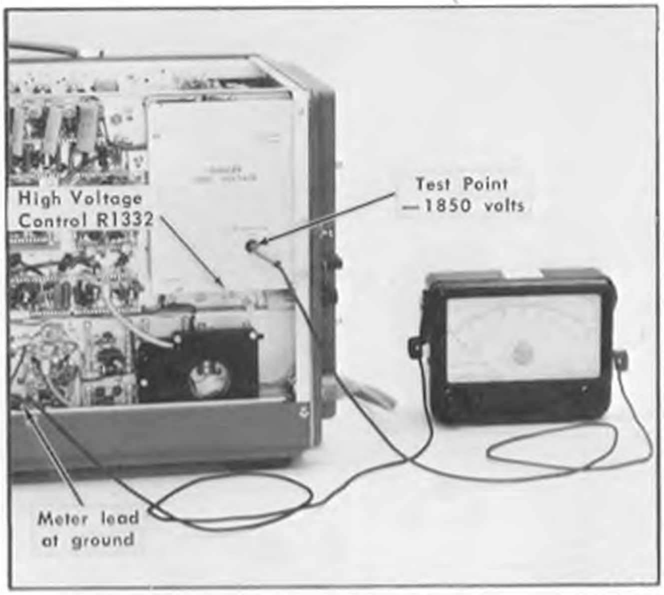


Fig. 6-10. Test setup for adjusting high voltage—Lower Beam.

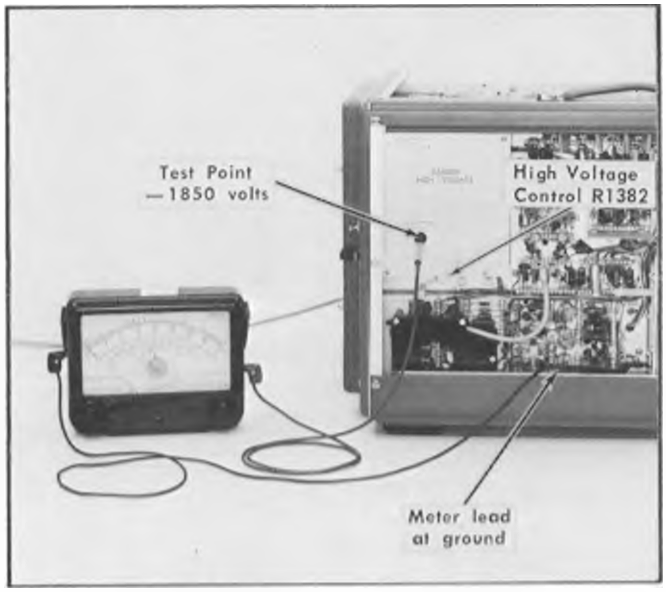


Fig. 6-11. Test setup for adjusting high voltage—Upper Beam.

NOTES

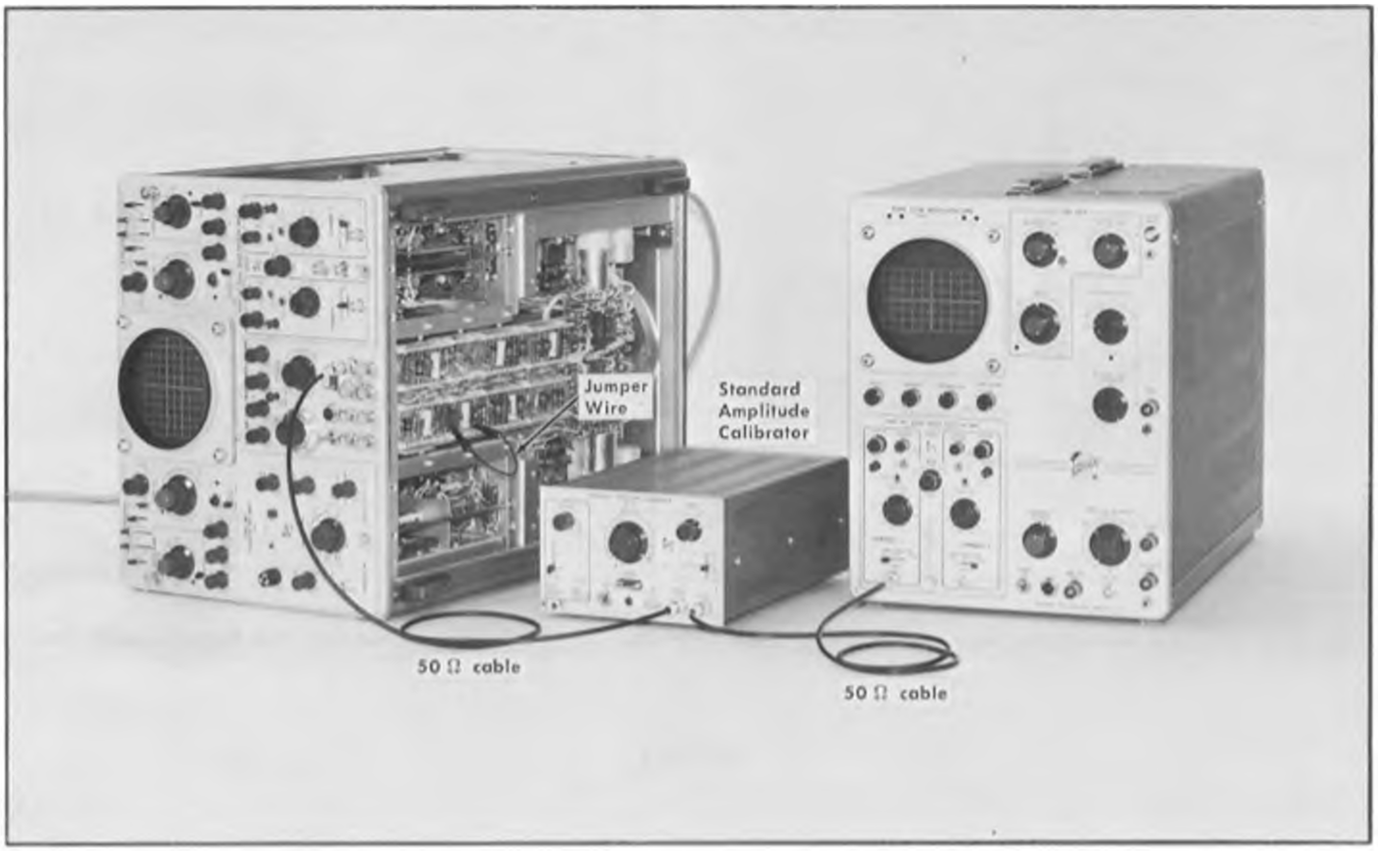


Fig. 6-12. Test setup for Amplitude Calibrator adjustment.

6. Adjust Amplitude Calibrator

a. Test equipment setup as shown in Fig. 6-12.

b. Connect a 50 Ω cable from the Type 556 CAL OUT connector to the Standard Amplitude Calibrator Unknown Input connector. Check that the Type 556 AMPLITUDE CALIBRATOR switch is set to 100 VDC.

c. Connect a 50 Ω cable from the test oscilloscope vertical input connector to the Output connector on the Standard Amplitude Calibrator. Set the Standard Amplitude Calibrator to 100 Volts, +DC, Mixed.

d. Set the test oscilloscope input for AC coupling, and the vertical deflection factor to 1 volt/cm.

e. Set the test oscilloscope controls for a free-running display centered on the graticule.

f. Check—Amplitude of display not more than 2 cm. See Fig. 6-14 for a typical display.

g. Adjust R1628 (Fig. 6-13) to reduce the display amplitude to zero.

h. Turn the Type 556 POWER switch off.

i. Connect a short jumper wire with insulated clips between the points shown in Fig. 6-13. Care should be used to avoid touching adjacent components or leads with the jumper terminal clips.

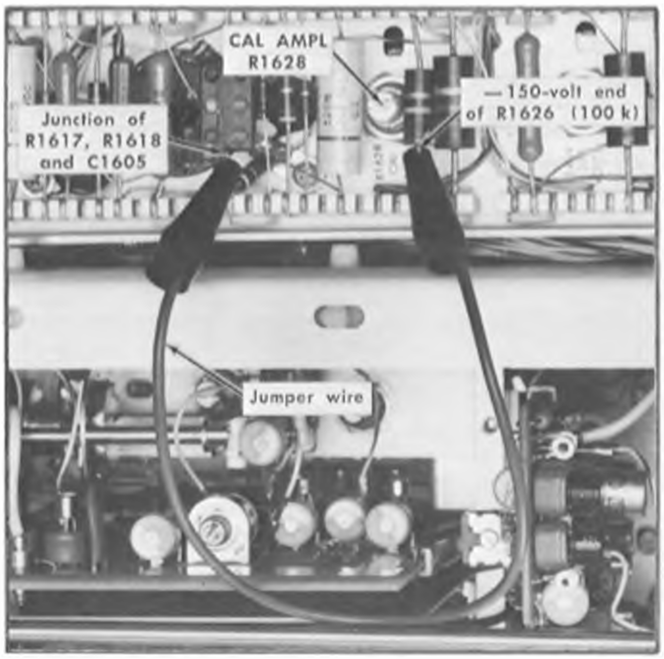


Fig. 6-13. Method of adjusting Amplitude Calibrator.

NOTE

The jumper wire applies −150 volts to the grid of V1605B, cutting it off and placing the cathode of V1605C at +100 volts for convenient checking of the AMPLITUDE CALIBRATOR switch divider network.

TABLE 6-2

Amplitude Calibrator Adjustment

AMPLITUDE CALIBRATOR VOLTS	Standard Calibrator Volts	Test Oscilloscope V/cm AC	Test Oscilloscope Deflection (max)
100	100	0.5	0 cm (adjusted)
50	50	0.5	2 cm
20	20	0.2	2 cm
10	10	0.1	2 cm
5	5	0.05	2 cm
2	2	0.02	2 cm
1	1	0.01	2 cm
.5	0.5	0.005	2 cm
.2	0.2	0.005	0.8 cm
.1	0.1	0.005	0.4 cm

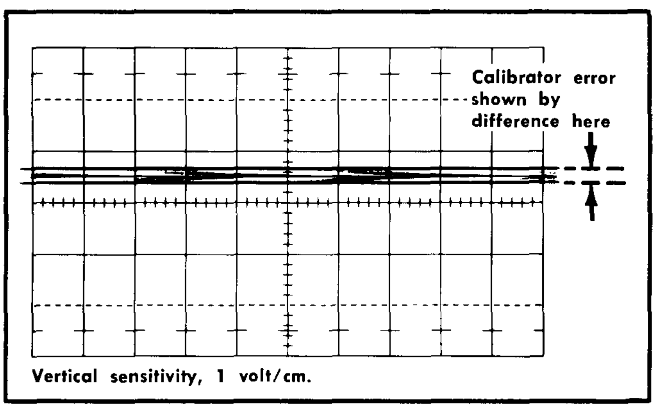


Fig. 6-14. Typical display, Amplitude Calibrator adjustment.

j. Turn the POWER switch to ON.

k. Set the AMPLITUDE CALIBRATOR and Standard Amplitude Calibrator switches as shown in Table 6-2, checking for the deflection tolerances listed.

7. Check Terminated Voltage Accuracy

a. Set the Type 556 AMPLITUDE CALIBRATOR to .2 VOLTS and the Standard Amplitude Calibrator to 0.1 V.

b. Insert the precision 50 Ω termination (item 16 listed under Recommended Equipment) between the Type 556 CAL OUT connector and the 50 Ω cable, using adapters as necessary.

c. With the test oscilloscope vertical deflection switch at 0.005 volts/cm, note a deflection of 0.4 cm or less.

d. Remove the Standard Amplitude Calibrator signal and the precision termination.

e. Turn off the Type 556 POWER switch, remove the jumper wire, and turn the POWER switch ON.

8. Check Amplitude Calibrator Repetition Rate

a. Set the AMPLITUDE CALIBRATOR to 1 VOLTS.

b. Connect an 18-inch 50 Ω cable (this cable is furnished with the Type 1A1) from the CAL OUT connector to the test oscilloscope vertical input.

c. Set the vertical deflection factor of the test oscilloscope plug-in to 0.5 volts/cm and obtain a stable display at a sweep rate of 0.2 milliseconds/cm.

d. Check—1 cycle of the displayed waveform between 3.75 cm and 6.25 cm in length.

9. Check Amplitude Calibrator Duty Cycle

a. Set the AMPLITUDE CALIBRATOR switch to 2 VOLTS.

b. With the vertical deflection factor of the plug-in at 0.5 volts/cm, obtain a stable display at a sweep rate of 0.1 milliseconds/cm.

c. With the horizontal positioning control, move the display so that the rising portion of the display coincides with the 1-cm vertical graticule line.

d. With the time/cm variable control, change the sweep rate so that one cycle of the calibrator signal is exactly 8 cm long.

e. Check—Falling portion of the waveform not more than 4 mm either side of the graticule center vertical line (duty cycle 45 to 55%).

10. Check Amplitude Calibrator Risetime

a. Change the variable time/cm control to the calibrated position.

b. Set the AMPLITUDE CALIBRATOR to 5 VOLTS.

c. Set the vertical deflection factor to 0.5 volts/cm, and adjust the display for a 5 cm vertical deflection with the variable volts/cm control.

d. Set the test oscilloscope time/cm to 0.2 microseconds, and adjust the triggering level control to display the full rising portion of the waveform.

e. Adjust the horizontal and vertical positioning controls simultaneously so that the 10% point of the rising portion of the waveform crosses an intersection of a vertical and a horizontal graticule line (see Fig. 6-15).

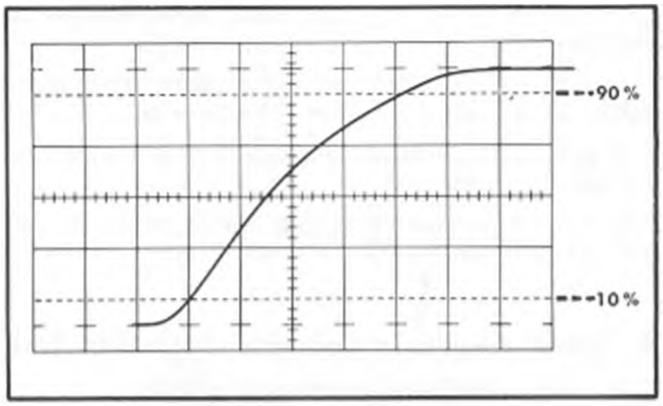


Fig. 6-15. Typical display, amplitude calibrator risetime. Indicated risetime is 0.8 microseconds.

f. Measure the horizontal distance between the 10% and 90% points on the rising portion of the waveform.

g. Check—Risetime 1.5 microseconds or less.

h. Change the test oscilloscope vertical deflection factor to 10 volts/cm.

i. Change the AMPLITUDE CALIBRATOR switch to 100 VOLTS.

j. Adjust the display as a step (e), with an amplitude of 5 cm.

k. Check—Risetime 1.5 microseconds or less.

l. Remove the 50 Ω cable.

11. Check 5 mA Current Loop

a. Connect the Type 134 Amplifier and P6019 Current-measuring Probe to the vertical input of the test oscilloscope.

b. Set the Type 134 Amplifier attenuator to 2 mA/div.

c. Change the test oscilloscope vertical deflection switch to 50 millivolts/cm.

d. Clip the probe to the current loop on the front panel of the Type 556.

e. Rotate the AMPLITUDE CALIBRATOR switch through all positions, noting that no waveform is displayed at any position except the 5 mA setting.

f. Check—Display amplitude of approximately 2.5 cm at the 5 mA switch position.

g. Remove the Type 134 Amplifier and Current-measuring Probe.

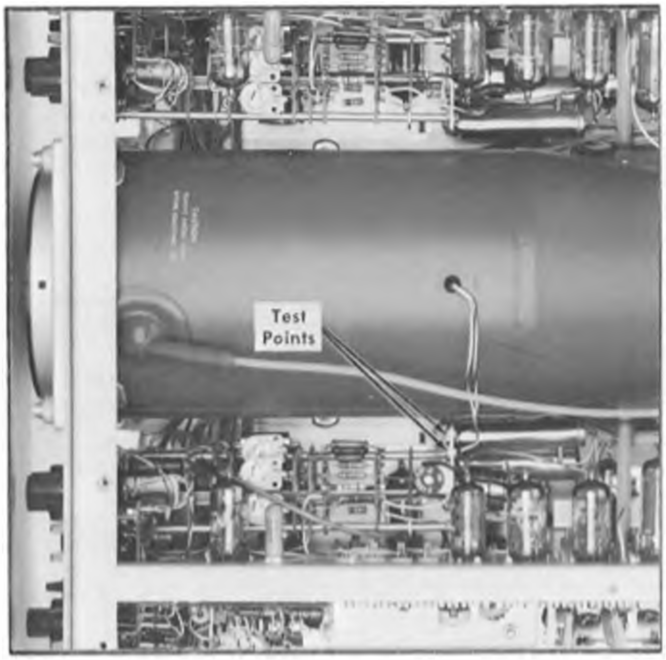


Fig. 6-16. Location of trace rotation coil test points.

12. Check Horizontal Deflection/Graticule Alignment

NOTE

The following steps (a) through (g) are to be performed only if the CRT has been replaced.

a. Set the voltmeter (item 9 of Recommended Equipment) to the 10 VDC scale.

b. Connect the voltmeter leads across the trace rotation coil test points (see Fig. 6-16).

c. Wih a small screwdriver, adjust the TRACE ROTATION control (in the center of the TRACE SEPARATION knob) for a reading of 0 on the voltmeter.

d. Set the A and B Triggering MODE switches to AUTO STABILITY. Adjust the Upper and Lower Beam INTENSITY, FOCUS and ASTIGMATISM controls to obtain well-defined traces.

e. Position the start of the A and B sweeps to the intersection of the 0-cm graticule line with the Upper and Lower Beam graticule horizontal center lines.

f. Note where the traces intersect the 10th cm graticule line.

g. Check—Maximum of 0.5 cm vertical deviation of each trace at the intersection of the trace with the 10th cm graticule line.

h. Adjust the TRACE ROTATION control for best alignment of the traces with the graticule horizontal lines. Remove the meter leads.

13. Check Beam Finder Switch Operation

a. Perform steps 12 (d) and 12 (e) if these steps have not already been performed.

b. Depress the BEAM FINDER button and hold in this position.

c. Rotate first the right and left vertical position controls fully clockwise and counterclockwise, and then the Upper Beam and Lower Beam POSITION controls, while observing the position of both displays.

d. Check—Both displays should remain within the graticule viewing areas while the BEAM FINDER button is depressed.

NOTES

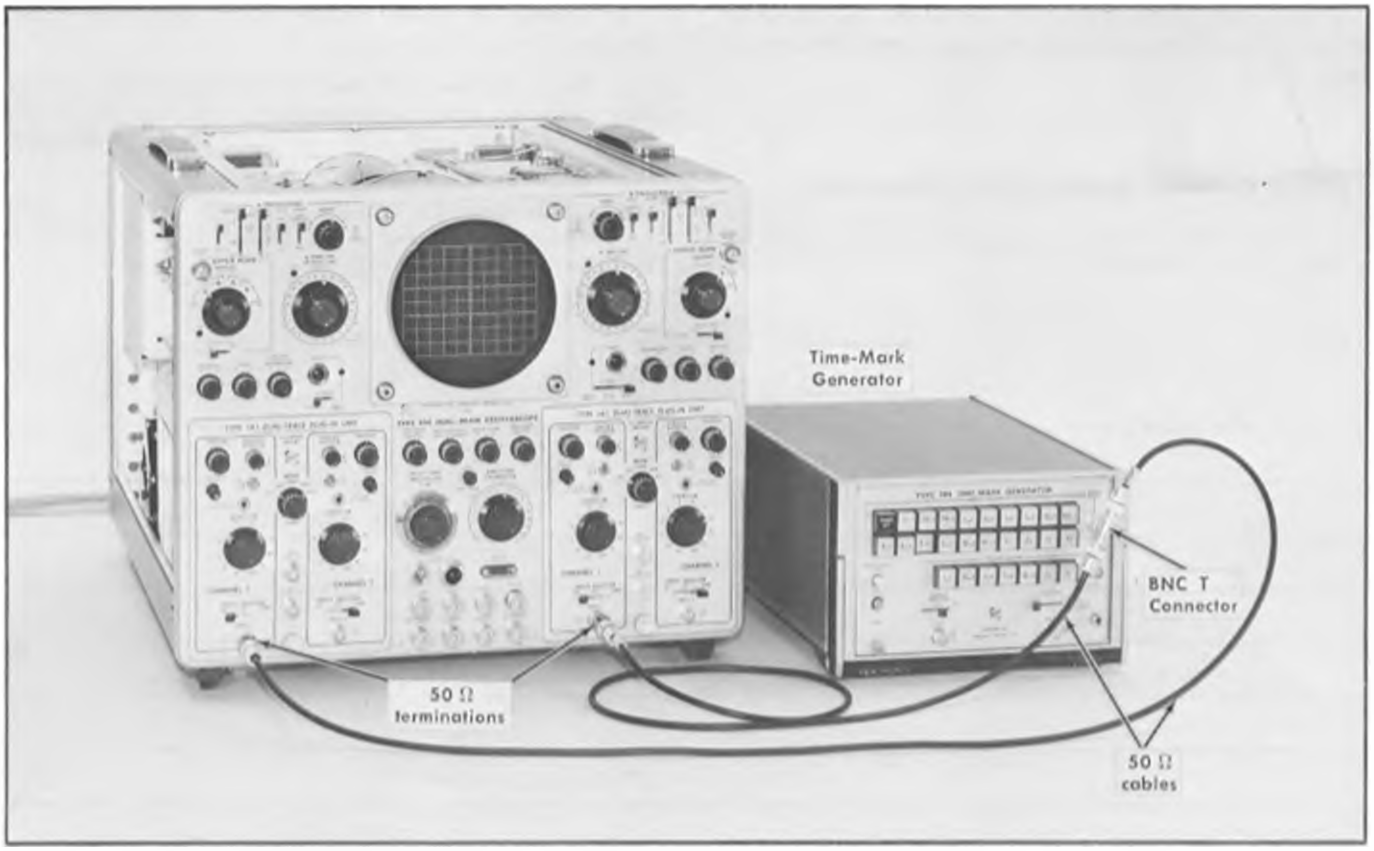


Fig. 6-17. Test setup for Geometry adjustment.

14. Adjust Geometry

a. Remove both Test Load units, and in their place install Type 1A1 plug-in units. The test equipment setup is shown in Fig. 6-17.

b. Apply 1-millisecond markers from the time-mark generator (item 4 of Recommended Equipment) through a BNC T connector, two 50 Ω cables and 50 Ω terminations to the Type 1A1 vertical inputs of both plug-ins.

c. Check that the A and B TIME/CM switches are set to .5 mSEC.

d. Adjust both plug-in variable volts/cm controls so that the displays over-scan both Upper and Lower Beam respective graticule areas.

e. Pull the A and B LEVEL control knobs outward and adjust the A and B Triggering controls for stable displays on both beams.

f. Adjust both plug-in vertical position controls so that the time-mark base line is below the viewing area for both beams.

g. Adjust the Upper and Lower Beam POSITION controls so that the first time marks for both beams are superimposed at the left-hand (0-cm) vertical graticule line.

h. Pre-adjust Sawtooth Amplitude controls R678 and R878 for approximately 10.5 cm sweep lengths. (See Fig. 6-33 and 6-36 for the locations of R678 and R878).

i. Adjust the A and B TIME/CM VARIABLE controls for one time mark per cm on both displays. Time marks will now be superimposed over the entire graticule area.

j. Check—Maximum deviation of the traces from vertical graticule lines should not exceed 1 mm. See Fig. 6-18 for examples of geometry adjustment.

k. Adjust Geometry controls R1391 and R1342 for minimum bowing of the marker traces. (See Fig. 6-19 for R1391 and R1342 locations).

l. Interaction—Remove the time-mark signals and recheck the TRACE ROTATION control adjustment.

m. Position the Lower Beam trace to the bottom graticule line and check for vertical trace deviation (bowing or tilt) of not more than 1 mm.

n. Position the Upper Beam trace to the top graticule line and check for vertical trace deviation (bowing or tilt) of not more than 1 mm.

o. Set the A and B TIME/CM VARIABLE controls to CALIBRATED.

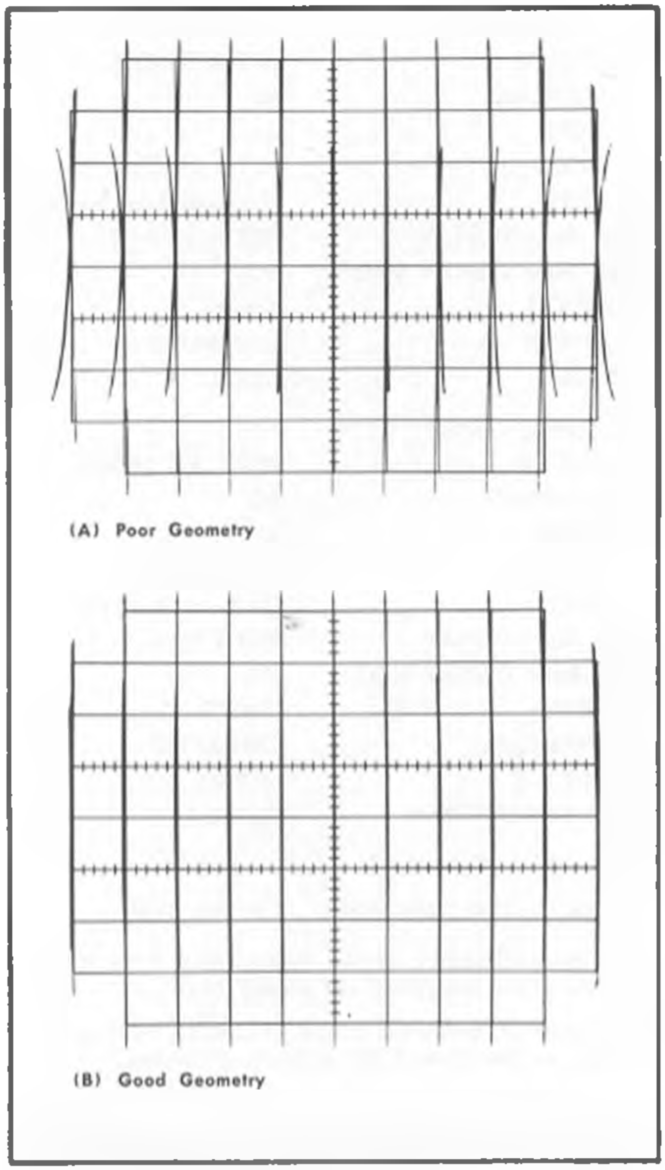


Fig. 6-18. Typical CRT displays showing (A) poor geometry adjustment; (B) good geometry adjustment.

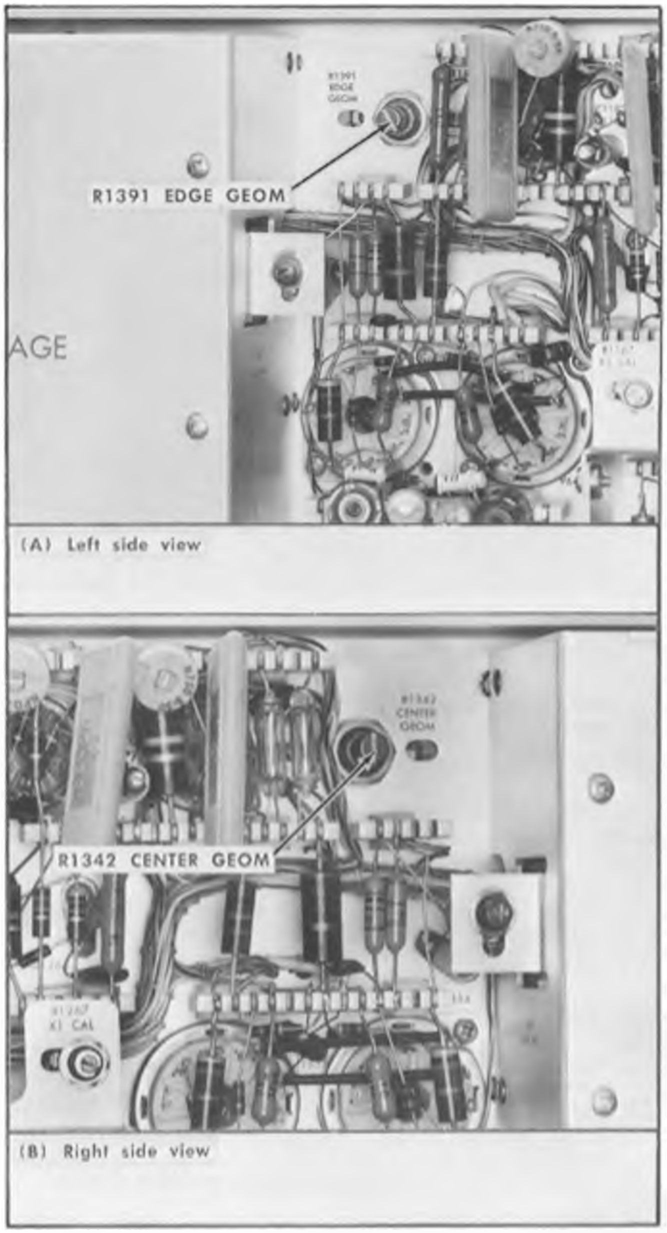


Fig. 6-19. Location of Edge and Center geometry adjustments.

15. Adjust FOCUS and ASTIGMATISM

a. Apply 100-microsecond time marks to both plug-in Vertical inputs.

b. Adjust both plug-in vertical position controls so that the time-mark base line is below the viewing area for both beams.

c. Adjust the Upper and Lower Beam FOCUS and ASTIGMATISM controls for sharp, well focussed displays on both beams.

16. Check Upper and Lower Beam Scan Areas

a. Change both A and B TIME/CM switches to .1 mSEC.

b. Set the time-mark generator for 1-microsecond markers.

c. Turn the Upper Beam INTENSITY control so that the Upper Beam display is no longer visible.

d. Adjust the right plug-in vertical deflection factor so that the raster produced by the markers over-scans the Lower Beam graticule area.

e. Check—The scan area equals or exceeds 6 × 10 cm.

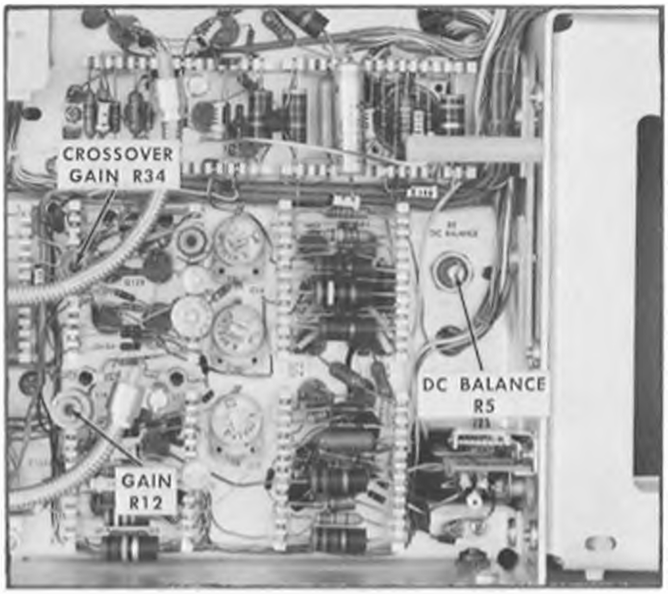


Fig. 6-20. Vertical amplifier DC balance and gain adjustments (left side view).

f. Extinguish the Lower Beam display with the INTENSITY control and turn the Upper Beam INTENSITY control to produce a display on the Upper Beam.

g. Check—The Upper Beam scan area equals or exceeds 6 × 10 cm.

17. Check CRT Orthogonality

a. Set the A TIME/CM switch to 1 mSEC.

b. Set the time-mark generator for 1-millisecond and 0.1-millisecond markers.

c. Adjust the A Triggering controls for a stable display.

d. Position an Upper Beam 1-millisecond marker at the intersection of a vertical graticule line and the horizontal graticule line 3 cm below the Upper Beam graticule center horizontal line.

e. Check—The adjacent 0.1 millisecond marker should not cross the Upper Beam graticule center vertical line at the point 3 cm above the Upper Beam graticule center horizontal line.

f. Repeat steps (a) through (e) for the Lower Beam.

g. Disconnect the time markers.

18. Adjust Vertical Amplifier DC Balance—Left

a. Remove the Type 1A1 vertical plug-in units and in their place install the test load units. Allow at least three minutes warm-up time.

b. Set the controls as follows:

A Triggering Controls	
SOURCE	LEFT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Clockwise, knob pushed in
Upper Beam DISPLAY	LEFT PLUG-IN A
Upper Beam DISPLAY MAG	×1
A TIME/CM	.5 mSEC
A VARIABLE	CALIBRATED
A MODE	NORM
B Triggering Controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Clockwise, knob pushed in
Lower Beam DISPLAY	RIGHT PLUG-IN B
Lower Beam DISPLAY MAG	×1
B TIME/CM	.5 mSEC
B VARIABLE	CALIBRATED
B MODE	NORM
TRACE SEPARATION	Centered
Test Load Unit Controls	
Test Function (both units)	Common Mode

c. Check—Deviation of the Upper Beam trace from its graticule center line should not exceed 0.5 cm.

d. Adjust DC BALANCE control R5 (see Fig. 6-20) to center the trace on the Upper Beam graticule center line.

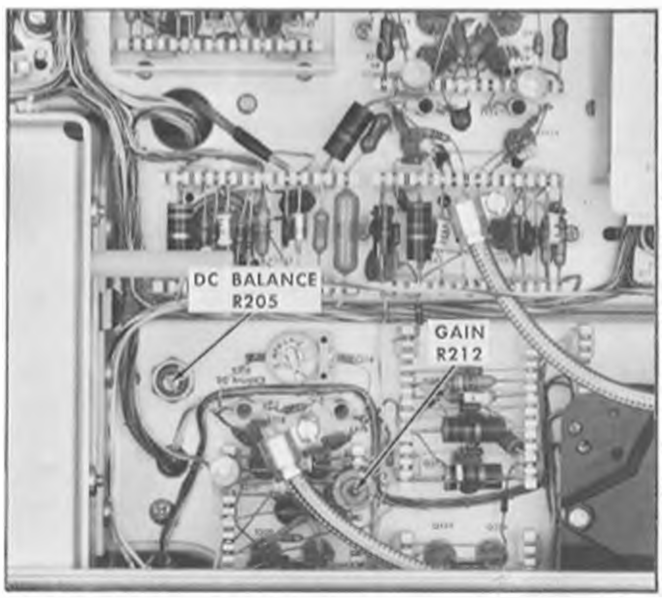


Fig. 6-21. Vertical amplifier DC balance and gain adjustments (right side view).

19. Adjust Vertical Amplifier DC Balance— Right

a. Check—Deviation of the Lower Beam trace from its graticule center horizontal line should not exceed 0.5 cm.

b. Adjust DC Balance control R205 (see Fig. 6-21) to center the trace on the Lower Beam graticule center horizontal line.

20. Check Trace Separation Range

a. Change the Upper Beam DISPLAY switch to RIGHT PLUG-IN A.

b. Change the right plug-in unit Test Function switch to Low Load.

c. Using the right plug-in unit Vertical Position control, position the Lower Beam trace to coincide with the horizontal graticule line located 1 cm below the Lower Beam graticule center horizontal line.

d. Using the TRACE SEPARATION control, position the Upper Beam trace so it is superimposed on the Lower Beam trace.

e. Check—The TRACE SEPARATION control should have sufficient range to superimpose the Upper Beam trace on the Lower Beam trace within the center 4-cm area of the graticule.

NOTES

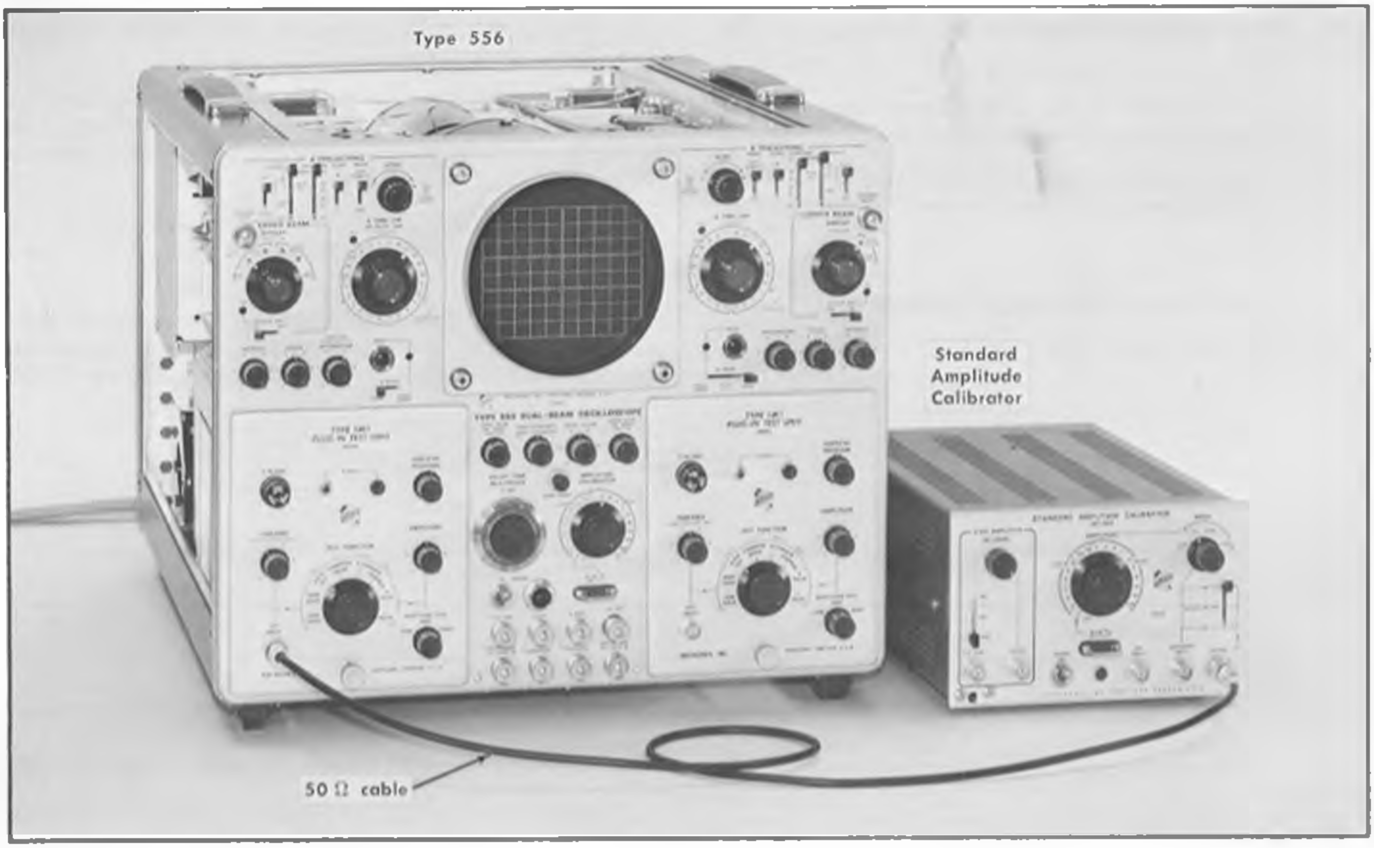


Fig. 6-22. Equipment setup for vertical amplifier gain adjustments.

21. Adjust Vertical Amplifier Gain

a. The equipment setup for this step is shown in Fig. 6-22.

b. Set the controls as follows:

A Triggering Controls	
SOURCE	LEFT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Clockwise, knob pulled outward
Upper Beam DISPLAY	LEFT PLUG-IN A
Upper Beam DISPLAY MAG	×1
A TIME/CM	.1 mSEC
A VARIABLE	CALIBRATED
A MODE	NORM
B Triggering Controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Clockwise, knob pulled outward
Lower Beam DISPLAY	RIGHT PLUG-IN B
Lower Beam DISPLAY MAG	×1
B TIME/CM	.1 mSEC
B VARIABLE	CALIBRATED
B MODE	NORM
TRACE SEPARATION	Centered
Test Load Unit (both)	
Test Function	Gain Set

c. Set both test load unit Test Function switches to Gain Set.

d. Connect a 50 Ω cable from the Standard Amplitude Calibrator Output connector to the left test load unit Ext Input connector.

e. Check that both A and B TIME/CM switches are set to .1 mSEC.

f. Set the Standard Amplitude Calibrator to supply a 100-V square-wave output.

g. Center the Upper Beam free-running display in the Upper Beam viewing area.

h. Change the B Triggering MODE switch to TRIG. The Lower Beam will no longer be visible.

i. Check—Display amplitude of 4 cm.

j. Adjust GAIN R12 (see Fig. 6-20) for a display amplitude of exactly 4 cm.

k. Remove the calibrator signal from the left plug-in unit and instead, connect the signal to the right plug-in test load Ext Input connector.

l. Change the B Triggering MODE switch to AUTO STABILITY and the A Triggering MODE switch to TRIG. The Lower Beam display will now be the only one visible.

m. Center the Lower Beam free-running display in the Lower Beam viewing area.

n. Check—Display amplitude of 4 cm.

o. Adjust GAIN R212 (see Fig. 6-21) for a display amplitude of exactly 4 cm.

p. Return the A Triggering MODE switch to AUTO STABILITY, and change the Upper Beam DISPLAY switch to RIGHT PLUG-IN A. Both beam displays will again be visible.

q. Decrease the Lower Beam INTENSITY control (counterclockwise rotation) until the Lower Beam display is no longer visible.

r. Use the TRACE SEPARATION control to center the Upper Beam free-running display in the Upper Beam viewing area.

s. Check—Display amplitude of 4 cm.

t. Adjust CROSSOVER GAIN R34 see Fig. 6-20) so that the Upper Beam display amplitude is exactly 4 cm.

22. Check Vertical Amplifier Compression/Expansion—Left, Right and Crossover

a. Equipment setup remains as in Step 21. Change the Standard Amplitude Calibrator to a 50-V square-wave output and apply the signal to the left plug-in unit.

b. Set the Upper Beam DISPLAY switch to LEFT PLUG-IN A and center the 2-cm display in the Upper Beam viewing area. Note the display amplitude.

c. With the left test load unit Vertical Position control, move the 2-cm display to the top 2 cm of the graticule.

d. Check—The change in display amplitude not to exceed ±0.5 mm.

e. Move the Upper Beam display so it is centered in the Lower Beam viewing area.

f. Check—The change in display amplitude not to exceed ±0.5 mm with respect to the amplitude noted in step (b).

g. Change the A Triggering MODE switch from AUTO STABILITY to TRIG. The Upper Beam display will now disappear.

h. Apply the Standard Amplitude Calibrator signal to the right plug-in unit.

i. Increase the Lower Beam INTENSITY control (clockwise rotation) until the Lower Beam display is visible.

j. Center the 2-cm display in the Lower Beam viewing area. Note the display amplitude.

k. With the right test load Vertical Position control, move the 2-cm display so it is centered in the Upper Beam viewing area.

l. Check—The change in display amplitude not to exceed ±0.5 mm.

m. Move the 2-cm display to the bottom 2 cm of the graticule.

n. Check—The change in display amplitude not to exceed ±0.5 mm with respect to the amplitude noted in step (j).

o. Return the A Triggering MODE switch to AUTO STABILITY.

p. Set the Upper Beam DISPLAY switch to RIGHT PLUG-IN A. The Upper and Lower Beam displays will now be visible. Decrease the intensity of the Lower Beam display.

q. Using the right test load Vertical Position control, center the Upper Beam 2-cm display in the Upper Beam viewing area. Note the display amplitude.

r. Move the 2-cm display to the top 2 cm of the graticule. Use the right test load Vertical Position control to move the display.

s. Check—The change in display amplitude not to exceed ±0.5 mm.

t. Use the right test load Vertical Position control to move the display so it is centered in the Lower Beam viewing area.

u. Check—The change in display amplitude not to exceed ±0.5 mm with respect to the amplitude noted in step (q).

23. Check Common Mode Rejection

a. Set the Standard Amplitude Calibrator to 1 volt square-wave output.

b. Connect a BNC T connector to the Standard Amplitude Calibrator Output connector. Using 50-Ω cables, apply the signal to both test load Ext Input connectors.

c. Set both the right and left test load unit Test Function switches to Common Mode.

d. Change the Upper Beam DISPLAY switch to LEFT PLUG-IN A and increase the intensity of the Lower Beam trace to normal brightness.

e. Check—The signal amplitude on both beam displays not to exceed 3 mm.

f. Change the Upper Beam DISPLAY switch to RIGHT PLUG-IN A.

g. Check—The signal amplitude on the Upper Beam display not to exceed 3 mm.

h. Remove the Standard Amplitude Calibrator signal from both test load unit inputs.

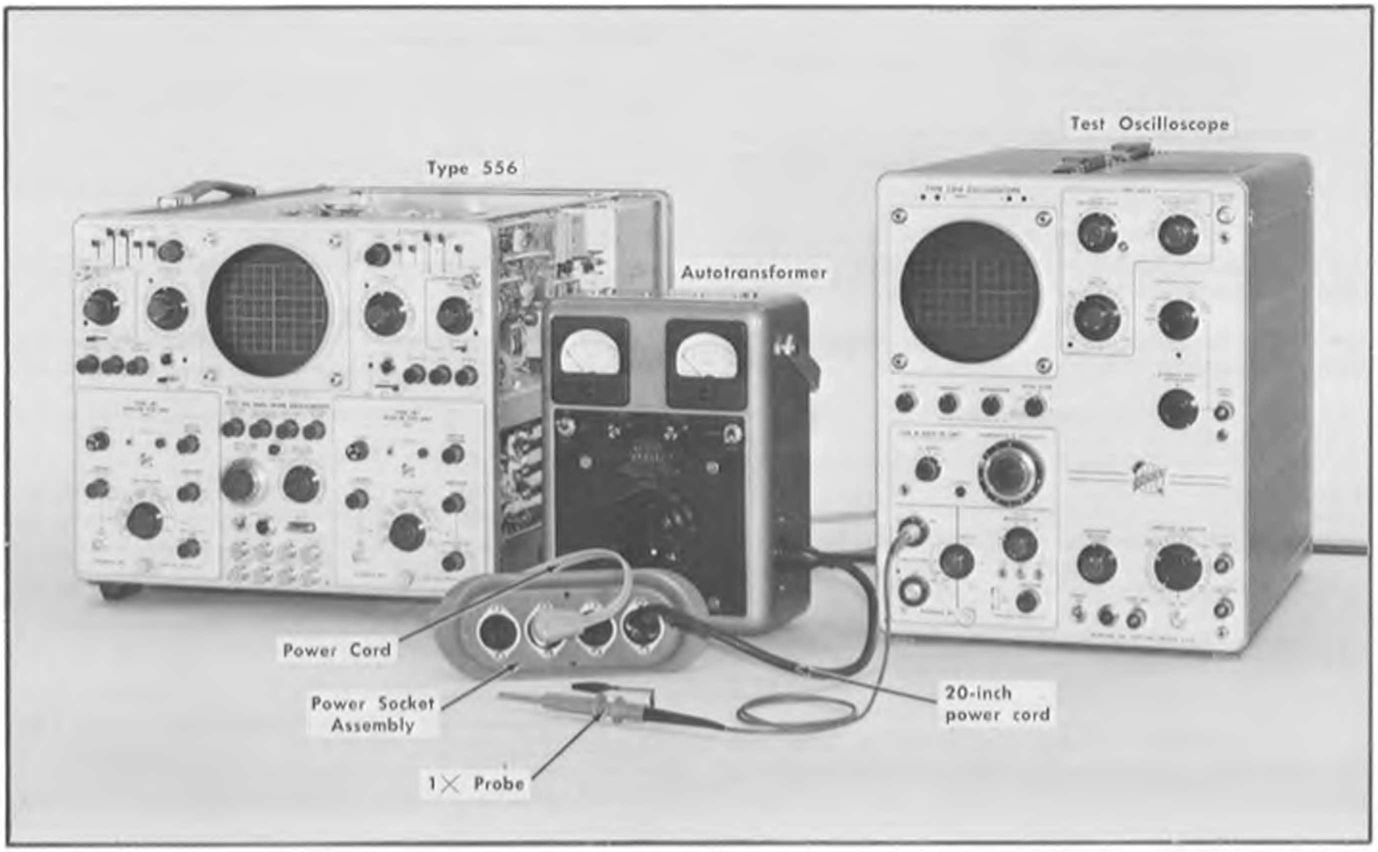


Fig. 6-23. Initial test setup for checking trace drift with line voltage change.

24. Check Trace Drift with Line Voltage Change

a. The test setup is shown in Fig. 6-23.

b. Set the controls as follows:

A Triggering Controls	
SOURCE	LEFT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Clockwise, knob pushed in
Upper Beam DISPLAY	LEFT PLUG-IN A
A TIME/CM	1 mSEC
B Triggering Controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Clockwise, knob pushed in
Lower Beam DISPLAY	RIGHT PLUG-IN B
B TIME/CM	1 mSEC
Test Load Unit (both)	
Test Function	Gain Set
Test Oscilloscope	
Time/cm	5 milliseconds
Type W	
AC-DC-GND (A)	DC
AC-DC-GND (B)	GND
Input Atten	100
Millivolts/cm	50
Display	A-Vc
Vc Range	0
Autotransformer	115 (RMS)

NOTE

The following procedure applies only to a Type 556 connected to a nominal 115-volt 3-wire power source. For an instrument connected to other than a nominal 115-volt source, a procedure and test fixtures adapted to local conditions will be required; for example, a 230-volt source will require an autotransformer with the higher output, an isolation transformer for the test oscilloscope, power sockets, etc.

c. Connect the 20-inch power cord between the autotransformer and the power socket assembly, and connect the Type 556 power cord to the power socket assembly, as shown in Fig. 6-23.

NOTE

The short power cord and the socket assembly (items 14 and 15 of Recommended Equipment) are used only to provide convenient measurement terminals with a minimum of hazard. If the autotransformer used is equipped with more than one output socket, the cord and socket assembly may be eliminated.

d. Connect a 1X probe to the test oscilloscope input connector.

e. Connect the probe ground lead to the ground pin of one of the sockets in the power socket assembly.

f. With the probe tip, determine which of the two remaining socket contacts is the neutral contact, and connect the probe tip to this contact.

g. Change the Type W Millivolts/cm switch to 20. The vertical deflection sensitivity should now be 2 volts/cm.

h. Measure the peak voltage of the waveform, as shown in Fig. 6-24.

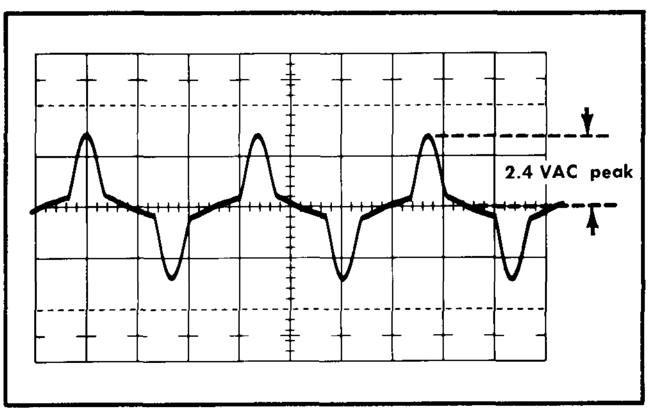


Fig. 6-24. Illustrating measurement of voltage drop in neutral wire. Probe connected between grounding pin and neutral wire; Type W Time/cm, 5 milliseconds; vertical sensitivity, 2 volts/cm.

i. Set the Type W Comparison Voltage (Vc) dial to 178 plus the reading obtained in step (h).

Example: If the reading obtained in step (h) was 2.4 volts, the dial should be set to 180.4.

j. With the right and left plug-in unit vertical position controls, adjust the Upper and Lower Beam traces to their respective graticule center horizontal lines.

k. Set the Vc Range to +11.

l. Change the Millivolts/cm switch to 10.

m. Move the probe tip from the neutral contact to the high-voltage or "hot" contact in the power socket assembly.

n. Adjust the autotransformer output until the tips of the waveforms shown on the test oscilloscope reach the reference line established previously by the Type W. (See Fig. 6-25 for typical display). The test oscilloscope is now indicating 183 peak VAC at the autotransformer output, or 130 volts RMS.

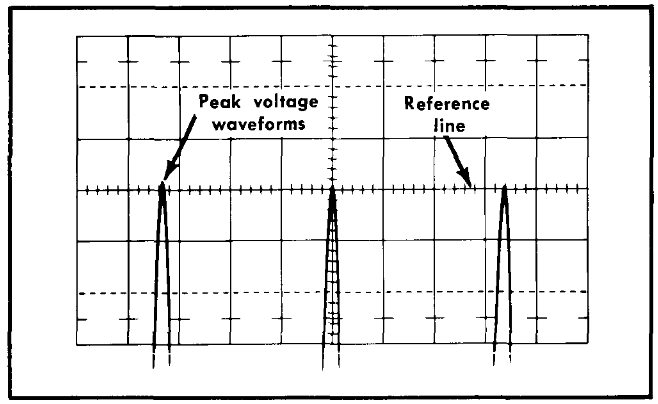


Fig. 6-25. Illustrating method of peak line voltage measurement; Type W plug-in vertical deflection factor 1 V/cm; sweep rate 5 milliseconds/cm.

o. Wait two minutes to allow the Type 556 to stabilize, and observe the position of the Upper and Lower Beam traces.

p. Check—*Vertical drift of either trace should not exceed 2 mm in the upward or downward direction.*

q. Return the autotransformer output to 115 volts.

r. Allow about 2 minutes at the 115-volt setting of the autotransformer, then recheck that the Upper and Lower Beam traces are on their respective center horizontal graticule lines.

s. Set the Type W Comparison Voltage (Vc) dial to 141.4 plus the reading obtained in step (h).

t. Adjust the autotransformer output until the tips of the waveform shown on the test oscilloscope reach the reference line established previously by the Type W. (See Fig. 6-25 for typical display). The test oscilloscope is now indicating 147 peak VAC at the autotransformer output, or 104 volts RMS.

u. Wait two minutes to allow the Type 556 to stabilize, and observe the position of the Upper and Lower Beam traces.

v. Check—Vertical drift of either trace should not exceed 2 mm in the upward or downward direction.

w. Return the autotransformer setting to 115 volts, disconnect the probe, and return the Type W Vc Range switch to 0.

25. Check Alternate Trace Operation

a. Connect the BNC T connector to the Type 556 CAL OUT connector. Connect two 50 Ω cables from the T connector to the Ext Input connectors on the right and left test load units.

b. Set the AMPLITUDE CALIBRATOR to 10 VOLTS, and set the Test Function switches on both Test Load units to Alternate.

c. Check—Two Traces on the Upper Beam display, with the calibrator signal appearing on only one trace.

d. Rotate the A TIME/CM switch through all positions from 1 mSEC to .1 μSEC, checking for two traces on the Upper Beam display for all positions.

e. Repeat steps (c) and (d) for the Lower Beam, checking for two traces in all positions of the B TIME/CM switch from 1 mSEC through .1 μSEC.

f. Change the Upper Beam DISPLAY switch to LEFT PLUG-IN B.

g. Rotate the B TIME/CM switch through all positions from 1 mSEC to .1 μSEC.

h. Check—Two traces displayed by each beam in all positions of the B TIME/CM switch.

i. Change the Upper Beam DISPLAY switch to RIGHT PLUG-IN A.

j. Rotate the A TIME/CM and B TIME/CM switches through all positions from 1 mSEC to .1 μSEC, keeping the A and B TIME/CM settings the same.

NOTE

With the Upper Beam DISPLAY switch in the RIGHT PLUG-IN A position, multiple traces will appear on both displays for some of the switch positions. This condition is normal.

k. Check—Two traces on each beam at all positions of the TIME/CM switches.

l. Change the Upper Beam DISPLAY switch to RIGHT PLUG-IN B.

m. Rotate the B TIME/CM switch through all positions from 1 mSEC to .1 μSEC.

n. Check—Two traces displayed by each beam at all settings of the TIME/CM switches from 1 mSEC through .1 μSEC.

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o. Set the Lower Beam DISPLAY switch to A.

p. Rotate the A TIME/CM and B TIME/CM switches through all positions from 1 mSEC to .1 μSEC, keeping the A and B TIME/CM settings the same.

q. Check—Two traces on each beam at all positions of the TIME/CM switches.

r. Return the Lower Beam DISPLAY switch to B.

s. Remove the AMPLITUDE CALIBRATOR signal from both plug-ins.

26. Check Multi-Trace Chopping Transient Blanking

a. Change both test load unit Test Function switches to Chopped.

b. Set the Upper Beam DISPLAY switch to LEFT PLUG-IN A.

c. Set both TIME/CM switches to 5 μSEC.

d. Adjust the A and B Triggering LEVEL controls for stable displays on both teams.

e. Change the Upper Beam CRT Cathode Selector switch (on rear panel) to UPPER BEAM CHOPPED BLANKING.

f. Check—Disappearance of fast chopping transients (vertical lines) on the Upper Beam display.

g. Repeat steps (e) and (f) with the Upper Beam DISPLAY switch in the LEFT PLUG-IN B, RIGHT PLUG-IN A, and RIGHT PLUG-IN B positions.

NOTE

With the Upper Beam DISPLAY switch in the RIGHT PLUG-IN A positioin, the A Triggering SOURCE switch should be changed to RIGHT for that one position only.

h. Change the Lower Beam CRT Cathode Selector switch (on rear panel) to LOWER BEAM CHOPPED BLANKING.

i. Check—Disappearance of fast chopping transients on the Lower Beam display.

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j. Set the Lower Beam DISPLAY switch to A and repeat steps (h) and (i).

k. Return the Lower Beam DISPLAY switch to B.

l. Reset both CRT Cathode Selector switches to EXTERNAL CRT CATHODE.

m. Disconnect the coaxial cables and BNC T connector.

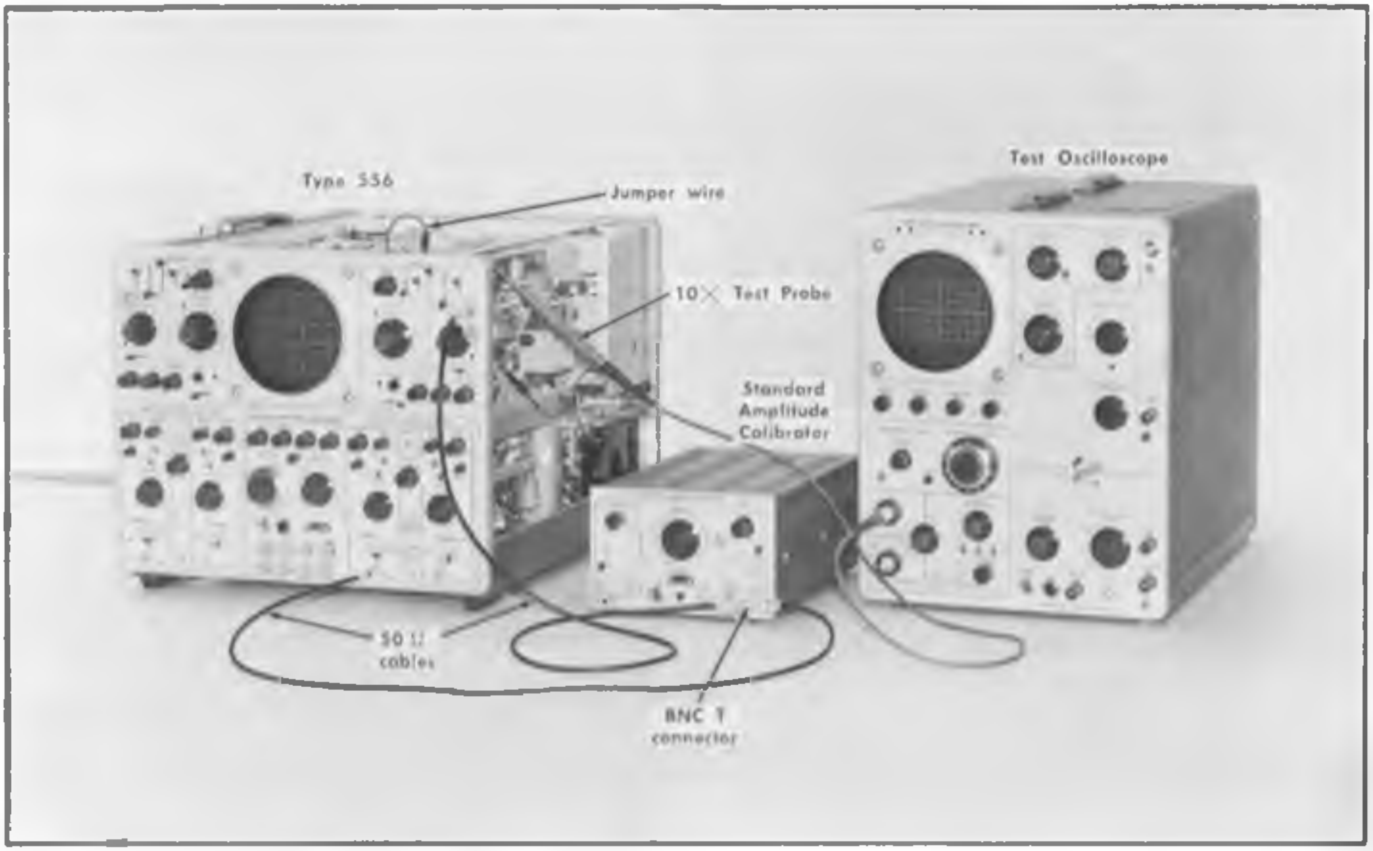


Fig. 6-26. Equipment setup for external triggering adjustments.

27. Adjust External Triggering—A and B Sweeps

a. Remove the Test Load units and in their place install the Type 1A1 plug-in units. Test equipment setup is shown in Fig. 6-26.

b. Set Controls as follows:

A Triggering Controls	
SOURCE	EXT
COUPLING	AC
SLOPE	+
MODE	TRIG
LEVEL	Centered, knob pushed in
Upper Beam DISPLAY	LEFT PLUG-IN A
Upper Beam DISPLAY MAG	×1
A TIME/CM	1 mSEC
A VARIABLE	CALIBRATED
A MODE	NORM
B Triggering Controls	
SOURCE	EXT
COUPLING	AC
SLOPE	+
MODE	TRIG
LEVEL	Centered, knob pushed in
Lower Beam DISPLAY	RIGHT PLUG-IN B
Lower Beam DISPLAY MAG	×1
B TIME/CM	1 mSEC
B VARIABLE	CALIBRATED
B MODE	NORM

c. Disable the B Triggering LEVEL control by connecting a short jumper wire from chassis ground to connecting pin Y on the B Triggering Switch circuit board. See Fig. 6-27.

d. Set the Standard Amplitude Calibrator to 2 volts.

e. Connect a BNC T and two 50 Ω cables from the Standard Amplitude Calibrator output connector to the input connector of the right plug-in, and the B Triggering TRIGGER INPUT connector.

f. Set the right plug-in vertical deflection switch to 1 volt/cm.

g. Place the right plug-in Input Selector switch to DC.

h. Set the test oscilloscope vertical deflection switch to 20 millivolts/cm, and the time/cm switch to 0.2 milliseconds.

i. Connect the 10× probe tip to the junction of R755 and R756. Fig. 6-28 shows the connecting point for the probe tip.

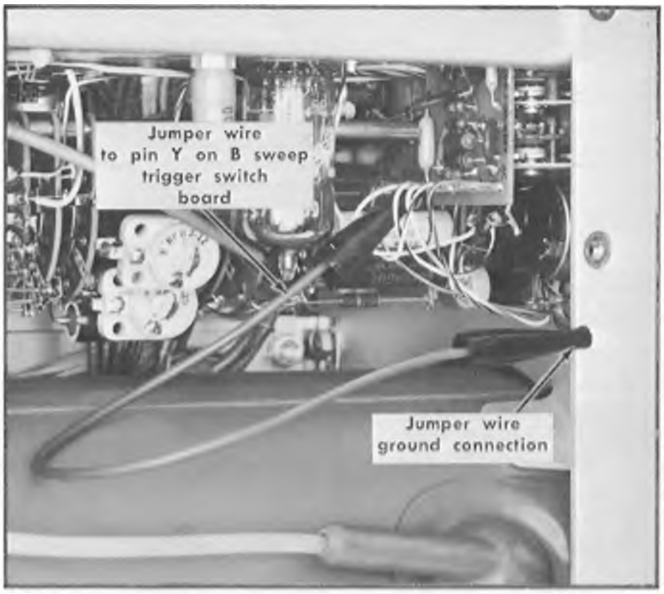


Fig. 6-27. Illustrating method of connecting jumper wire to adjust triggering.

j. Adjust the test oscilloscope triggering controls for a stable display.

k. Change the Standard Calibrator to 0.1 volts.

NOTE

The signal amplitudes given in steps 27 (k), (o), (v) and (z) are used as calibration adjustment aids only and therefore will not be the same as those given in the Characteristics section.

l. Check—Stable Lower Beam displays in both the + and — positions of the SLOPE switch.

m. Adjust Trigger Sensitivity R756 and B Trigger Level Centering R745 to obtain the correct stable display on the test oscilloscope as shown in Fig. 6-29. The locations of R756 and R745 are shown in Fig. 6-28.

n. Adjust R756 counterclockwise slowly until the Lower Beam display disappears, then clockwise until the display reappears and remains stable.

o. Change the Standard Amplitude Calibrator to 50 millivolts.

p. Check—No stable display on the Lower Beam in either position of the SLOPE switch.

q. Remove the test probe from the B Triggering circuit and connect it to the corresponding point in the A Triggering circuit, as in step (c) and (i). See Fig. 6-27. Remove the jumper wire from the B Triggering circuit and connect it between chassis ground and pin Y on the A Trigger Switch board. (Use Fig. 6-27 as a guide to illustrate corresponding connections.)

r. Change the two 50 Ω cables from the right plug-in input connector and the B Triggering TRIGGER INPUT connector to the left plug-in input connector and the A Triggering TRIGGER INPUT connector.

s. Set the Standard Calibrator to 2 volts.

t. Set the left plug-in vertical deflection switch to 1 volt/cm and the Input Selector switch to DC.

u. Adjust the test oscilloscope triggering controls for a stable display.

v. Change the Standard Calibrator to 0.1 volts.

w. Check—Stable Upper Beam displays in both the + and — positions of the SLOPE switch.

x. Adjust Trigger Sensitivity R556 and Trigger Level Centering R545 for a stable display on the test oscilloscope as in step (m). The locations of R556 and R545 are shown in Fig. 6-30.

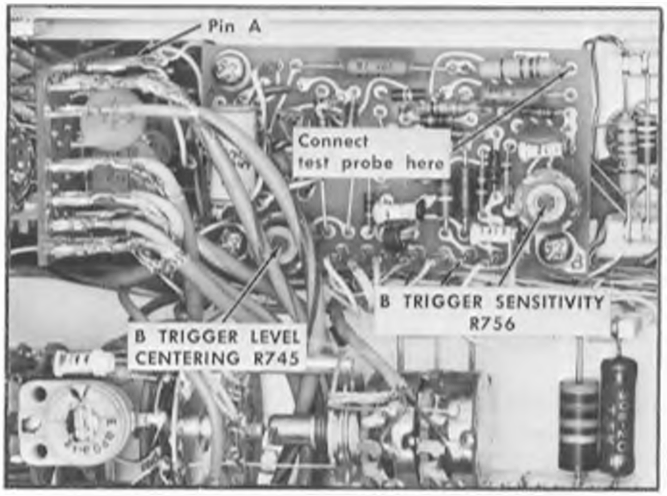


Fig. 6-28. External triggering adjustment locations, B sweep.

y. Adjust R556 slowly counterclockwise until the Upper Beam display disappears, then slowly clockwise until the display reappears and remains stable.

z. Change the Standard Amplitude Calibrator to 50 millivolts.

aa. Check—No stable display on the Upper Beam in the + or — positions of the SLOPE switch.

ab. Remove the test probe and jumper wire.

ac. Remove the Standard Amplitude Calibrator Signal.

28. Check B Triggering LEVEL Control Ranges

a. Connect a 10× probe from the test oscilloscope pin A (to grid of V734B) on the B trigger switch board (see Fig. 6-28). Check that the B Triggering SLOPE switch is set to +.

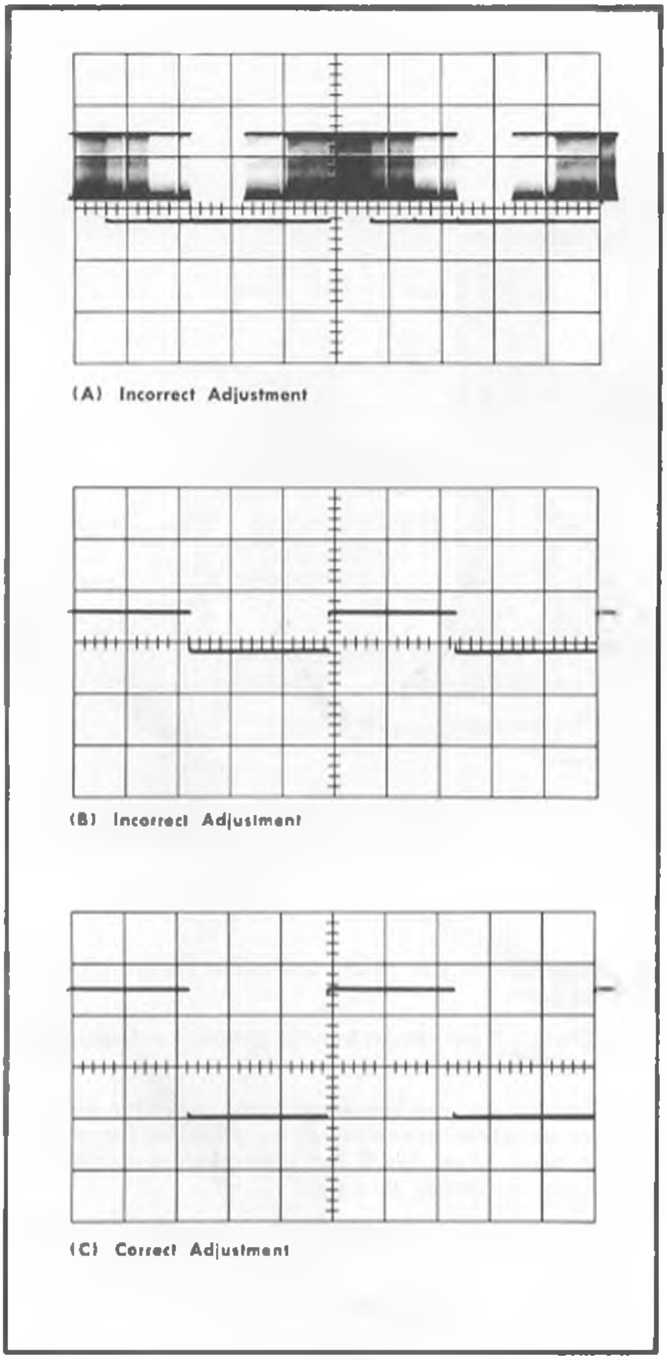


Fig. 6-29. Trigger adjustment waveforms.

b. Set the test oscilloscope vertical deflection switch to 0.2 volts/cm, DC coupling.

c. Rotate the B Triggering LEVEL control fully clockwise and counterclockwise.

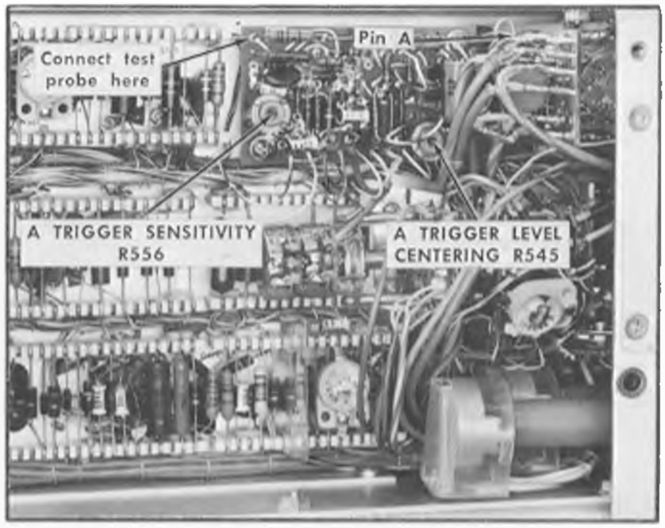


Fig. 6-30. External triggering adjustment locations, A sweep.

d. Check—Control range must be ±2 volts minimum from center position.

e. Set the test oscilloscope vertical deflection switch to 2 volts/cm.

f. Pull B Triggering LEVEL control out to obtain a ×10 range increase.

g. Check—Control range must be ±20 volts minimum from center position.

h. Push the LEVEL knob in and remove the test probe.

29. Check A Triggering LEVEL Control Ranges

a. Connect the 10× probe to pin A (to grid of V534B) on the A trigger switch board (see Fig. 6-30). Check that the Type 556 A Triggering SLOPE switch is set to +. Set the test oscilloscope vertical deflection switch to 0.2 Volts/cm.

b. Rotate the A Triggering LEVEL control fully clockwise and counterclockwise.

c. Check—Control range must be ±2 volts minimum from the center position.

d. Set the test oscilloscope vertical deflection switch to 2 volts/cm.

e. Pull the A Triggering LEVEL control out to obtain ×10 range increase.

f. Check—Control range must be ±20 volts minimum from the center position.

g. Push the LEVEL knob in and remove the probe.

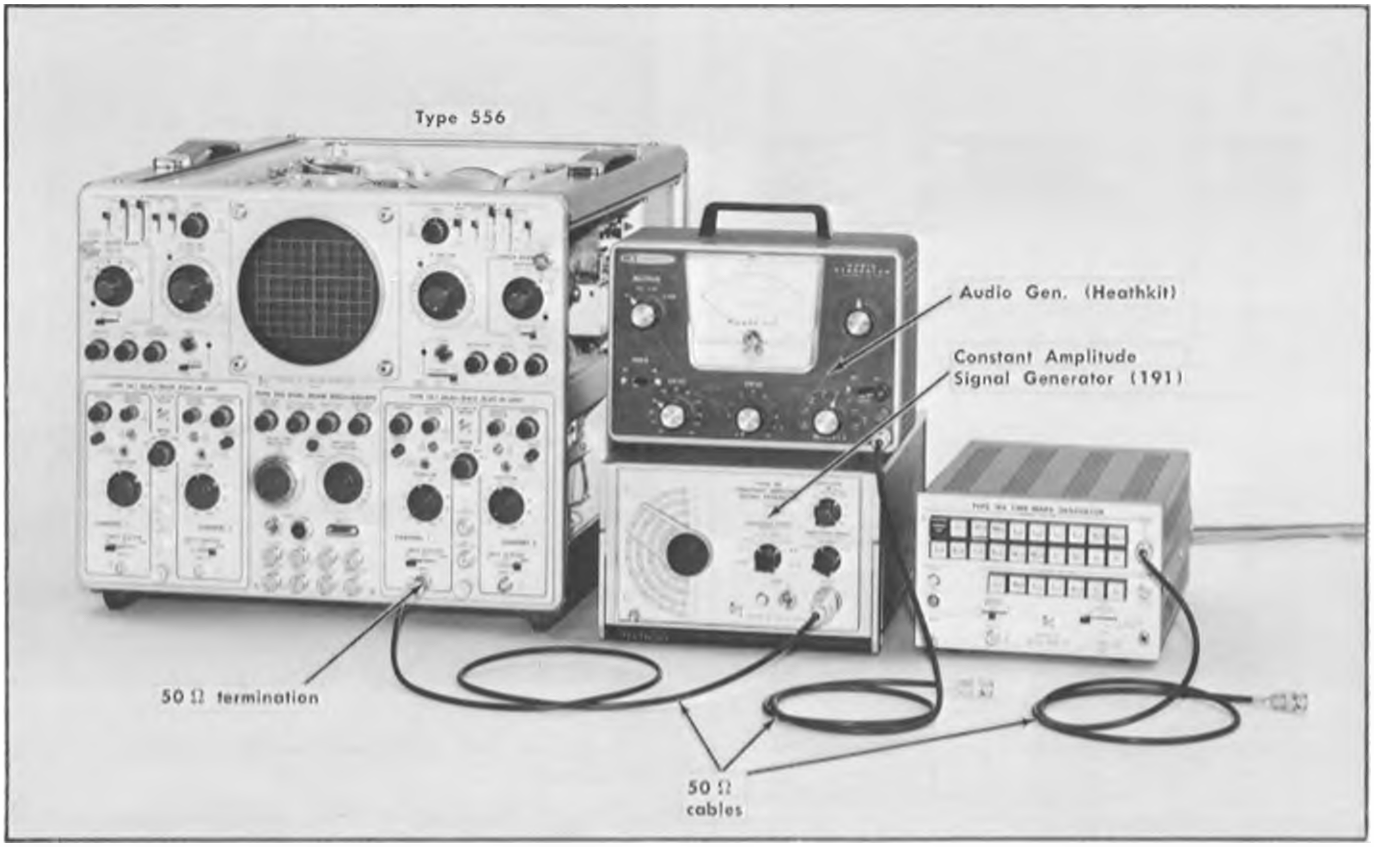


Fig. 6-31. Test setup for checking internal trigger.

30. Check Internal Triggering—Lower Beam

a. The test equipment setup is shown in Fig. 6-31.

b. Set the B Triggering SOURCE switch to RIGHT INT NORM, the MODE switch to AUTO STABILITY, and the B TIME/CM switch to .2 μSEC.

c. Set the constant-amplitude generator for a 10 MHz signal, and adjust the plug-in unit vertical controls to display a signal 2 mm in amplitude.

d. Check—Stable displays can be obtained on the Lower Beam with the B Triggering COUPLING switch in the AC and AC LF REJ positions. The LEVEL control may be adjusted as necessary to obtain a stable display.

NOTE

If desired, set the B Triggering MODE switch to TRIG when performing the "Check" steps in this procedure (step 30). Use the AUTO STABILITY position between the "Check" steps when setting up the display amplitude.

e. Remove the constant amplitude generator signal from the right plug-in connector and connect the output of the low-frequency signal generator through a coaxial cable to the same connector.

f. Set the Type 556 B Triggering COUPLING switch to AC HF REJ and the B TIME/CM switch to 50 μSEC. Set the generator frequency to 60 kHz and adjust the display amplitude to 2 mm.

g. Check—Stable display may be obtained with adjustment of the LEVEL control.

h. Replace the low-frequency signal generator with the constant amplitude generator; set the generator frequency to 6 MHz. Set the Type 556 B TIME/CM switch to .5 μSEC, and the display amplitude to 1 cm.

i. Check—No stable display with adjustment of the LEVEL control.

j. Change the B Triggering SOURCE switch to PLUG-IN INT and the COUPLING switch to AC.

k. Set the right plug-in Variable Volts/cm control to Calib, the Volts/cm switch to 0.05, and set the generator amplitude control for a display on the Lower Beam.

l. Check—Stable display may be obtained while adjusting the LEVEL control.

m. Remove the constant-amplitude generator signal from the right plug-in unit input connector, and connect the output of the low-frequency signal generator to the same connector.

n. Set the generator output for 60-Hz sine waves.

o. Set the B TIME/CM switch to 5 mSEC so several cycles of the waveform are displayed, and set the B Triggering SOURCE switch to RIGHT INT NORM. Adjust the plug-in unit vertical attenuation for a display 2 mm in amplitude.

p. Check—Stable displays may be obtained on the Lower Beam with the B Triggering COUPLING switch in the AC and AC HF REJ positions. The LEVEL control may be adjusted as necessary to obtain stable displays.

q. Increase the display amplitude to 3.5 mm.

r. Change the B Triggering COUPLING switch to DC.

s. Check—Stable displays may be obtained while adjusting the LEVEL control.

t. Change the generator to 30 Hz, the B TIME/CM switch to 10 mSEC, and adjust the display amplitude to 3 cm.

u. Change the B Triggering COUPLING switch to AC LF REJ.

v. Check—No stable displays may be obtained while adjusting the LEVEL control.

w. Change the generator frequency to 2.5 kHz, set the B TIME/CM switch to 1 mSEC, and adjust the amplitude of the display to 2 mm.

x. Check—Stable displays may be obtained with adjustment of the LEVEL control.

31. Check Internal Triggering—Upper Beam

a. Set the A Triggering SOURCE switch to LEFT INT NORM, the MODE switch to AUTO STABILITY.

b. Change the low-frequency generator output signal to the left plug-in unit input connector, and adjust the signal amplitude to 2 mm on the Upper Beam display.

c. Set the A TIME/CM switch to 1 mSEC.

d. Set the A Triggering COUPLING switch to AC LF REJ.

e. Check—Stable displays may be obtained on the Upper Beam while adjusting the LEVEL control.

NOTE

If desired, set the A Triggering MODE switch to TRIG when performing the "Check" steps in this procedure (Step 31). Use the AUTO STABILITY position between the "Check" steps when setting up the display amplitude.

f. Change the generator frequency to 30 Hz, and change the A TIME/CM switch to 10 mSEC.

g. Adjust the signal amplitude to 3 cm.

h. Check—No stable display while adjusting the LEVEL control.

i. Change the generator frequency to 60 Hz, and the A TIME/CM switch to 5 mSEC.

j. Adjust the signal amplitude to 2 mm.

k. Stable displays may be obtained with the COUPLING switch in AC and AC HF REJ, while adjusting the LEVEL control.

l. Increase the amplitude of the display to 3.5 mm.

m. Change the COUPLING switch to DC.

n. Check—Stable displays may be obtained while adjusting the LEVEL control.

o. Remove the low-frequency signal, and connect the constant-amplitude signal generator output through a 50 ohm cable and 50 ohm termination to the left plug-in unit vertical input connector.

p. Set the generator frequency to 10 MHz.

q. Set the A TIME/CM switch to .2 μSEC and adjust the left plug-in unit controls so the display is 2 mm in amplitude.

r. Check—Stable displays may be obtained on the Upper Beam with the A Triggering COUPLING switch in the AC and AC LF REJ positions. The LEVEL control may be adjusted as necessary to obtain a stable display.

s. Remove the constant amplitude generator signal from the left plug-in connector and connect the output of the low-frequency signal generator through a coaxial cable to the same connector.

t. Set the A Triggering COUPLING switch to AC HF REJ and the A TIME/CM switch to 50 μSEC. Set the generator frequency to 60 Hz and adjust the display amplitude to 2 mm.

u. Check—Stable displays may be obtained with adjustment of the LEVEL control.

v. Replace the low-frequency signal generator with the constant amplitude generator; set the generator frequency to 6 MHz. Set the Type 556 A TIME/CM switch to .5 μSEC, and the display amplitude to 1 cm.

w. Check—No stable display with adjustment of the LEVEL control.

x. Change the A Triggering SOURCE switch to PLUG-IN INT and the COUPLING switch to AC.

y. Set the left plug-in Variable Volts/cm control to Calib, the Volts/cm switch to 0.05, and set the generator amplitude control to obtain a 4-mm display on the Upper Beam.

z. Check—Stable displays may be obtained while adjusting the LEVEL control.

32. Check Crossover Triggering

a. Set the Upper Beam DISPLAY switch to RIGHT PLUG-IN A, the A Triggering SOURCE to RIGHT INT NORM, the MODE switch to TRIG and the A TIME/CM switch to .2 μSEC.

b. Set the B Triggering LEVEL fully clockwise and MODE switch to AUTO STABILITY the COUPLING switch to AC and the B TIME/CM switch to .2 μSEC.

c. Set the constant-amplitude signal generator to supply a 10 MHz signal and connect the signal to the right plug-in unit input connector. Adjust the right plug-in unit controls to display a signal 2 mm in amplitude on the Upper Beam.

d. Check—Stable display on the Upper Beam while adjusting the A Triggering LEVEL control.

e. Remove the generator signal.

33. Check Auto Stability Operation

a. Connect a 30 Hz sine-wave signal from a low-frequency generator to the right plug-in input connector and set the B TIME/CM switch to 10 mSEC.

b. Adjust the plug-in for a display 1 cm in amplitude.

c. Rotate the B Triggering LEVEL control from a fully counterclockwise position through 0 to the fully clockwise position.

d. Check—Triggered (stable) display near the 0 position, and a free-running display in the remainder of the rotation area.

e. Remove the generator signal from the right plug-in connector and apply the signal to the left plug-in input connector.

f. Set the A Triggering SOURCE switch to LEFT INT NORM, MODE switch to AUTO STABILITY, Upper Beam DISPLAY switch to LEFT PLUG-IN A and the A TIME/CM switch to 10 mSEC.

g. Use steps (b) through (d) as a guide to check the A Triggering AUTO STABILITY operation.

h. Remove the generator signal.

34. Check Line Trigger and LF Reject Operation

a. Connect a 10× probe to the right plug-in input connector.

b. Preset the right plug-in vertical deflection to a factor (100 V/cm with 10× probe) that will permit an on-screen display when the signal in step (d) is applied.

c. Set the B TIME/CM switch to 5 mSEC.

d. Set the B Triggering SOURCE switch to LINE RIGHT, and connect the probe tip to the oscilloscope line voltage source.

e. Check—Stable display with adjustment of the LEVEL control.

f. Change the SLOPE switch from + to —.

g. Check—Correct trigger polarity with the change of the SLOPE switch.

h. Change the SOURCE switch to NORM INT RIGHT.

i. Check—Stable display with adjustment of the LEVEL control.

j. Change the COUPLING switch to AC LF REJ.

k. Check—No stable display with adjustment of the LEVEL control.

l. Return the COUPLING switch to AC and remove the probe.

35. Check A and B Single Sweep Operation

a. Set the Standard Amplitude Calibrator to 1 volt square-wave output and apply the signal to the left plug-in input connector.

b. Set the left plug-in vertical deflection switch to 1 volt/cm and set the A TIME/CM switch to .5 mSEC.

c. With the variable volts/cm control, adjust the Upper Beam display amplitude for 5 mm, and adjust the A Triggering controls for a stable display.

d. Change the A MODE switch to SINGLE SWEEP, the A Triggering MODE switch to TRIG and remove the Standard Amplitude Calibrator signal from the left plug-in input connector.

e. Depress the A sweep RESET button, and note that the single-sweep indicator light is lit.

f. Re-apply the Standard Amplitude Calibrator signal to the input connector.

g. Check—The sweep runs once, and the indicator light is extinguished.

h. Use steps (b) through (f) as a guide for the B sweep, the right plug-in and Type 556 front-panel control settings.

i. Check—The B sweep runs once, and the indicator light is extinguished.

j. Return the A and B MODE switches to NORM, and remove the Standard Amplitude Calibrator signal.

NOTES

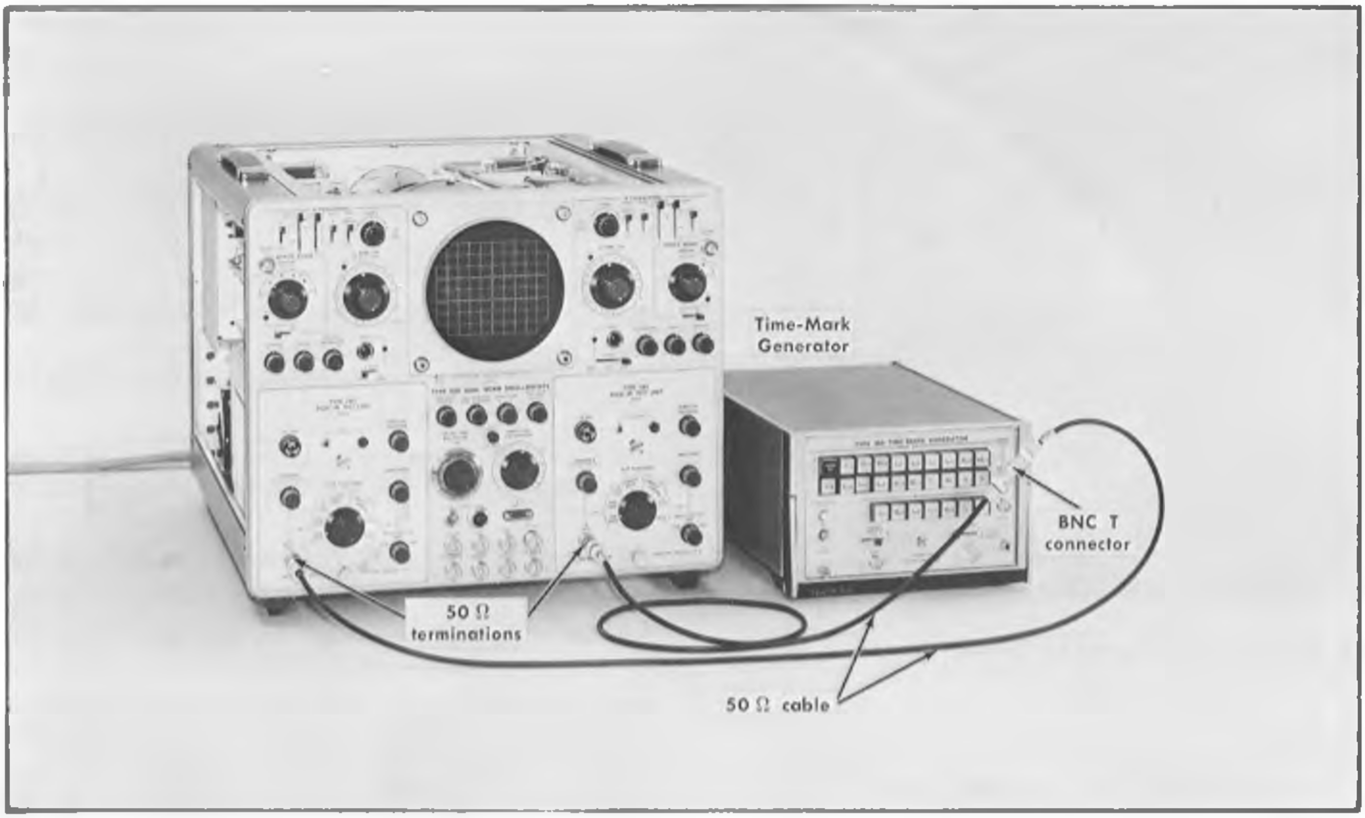


Fig. 6-32. Equipment setup for basic timing procedures—A and B sweeps.

36. Adjust Basic Timing—A Sweep

a. Remove the Type 1A1 units and install Test Load units in their place. The test equipment setup is shown in Fig. 6-32

b. Set controls as follows:

A Triggering Controls	
SOURCE	LEFT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Near 0, knob pushed in
Upper Beam DISPLAY	LEFT PLUG-IN A
Upper Beam DISPLAY MAG	×1
A TIME/CM	1 mSEC
A VARIABLE	CALIBRATED
A MODE	NORM
B Triggering Controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Near 0, knob pushed in
Lower Beam DISPLAY	RIGHT PLUG-IN B
Lower Beam DISPLAY MAG	×1
B TIME/CM	1 mSEC
B VARIABLE	CALIBRATED
B MODE	NORM
Test Load Units (both)	
Test Function	Low Load

c. Connect a BNC T connector, two 50 Ω cables and two 50 Ω terminations from the time-mark generator to both Test Load unit Ext Input connectors.

d. Set the time-mark generator for 1-millisecond and 100-microsecond markers.

e. Adjust the A and B Triggering controls for stable displays in the Upper and Lower Beam graticule viewing areas.

f. Set the Upper Beam DISPLAY MAG switch to ×10.

g. Check—One 100-microsecond marker/cm.

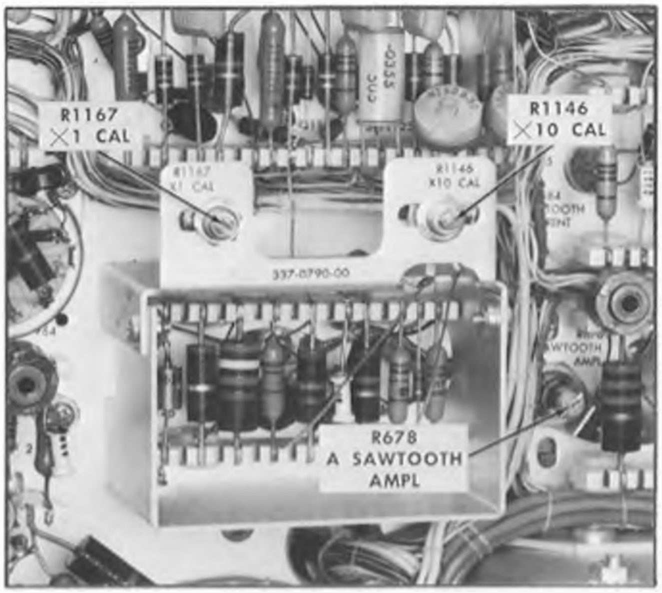


Fig. 6-33. Adjustment location for A sweep basic timing and sawtooth amplitude.

NOTE

When adjusting or checking sweep timing, or when making time measurements from the graticule, the area between the first-cm and ninth-cm graticule lines provides the most linear measurement. Therefore the 0-cm to 1-cm and the 9-cm to 10-cm areas of the display should not be used for making accurate time measurements. See Fig. 2-7 in Selecting Sweep Rate, Section 2 of this manual.

h. Adjust R1146 (see Fig. 6-33) for one 100-microsecond marker/cm.

i. Change the Upper Beam DISPLAY MAG switch to ×1.

j. Check—One 1-millisecond marker/cm.

k. Adjust R1167 for one 1-millisecond marker/cm. See Fig. 6-33; R1167 is located adjacent to the ×10 CAL control R1146.

l. Interaction—Repeat steps (f) through (k) for accurate adjustment, as necessary.

37. Adjust Upper Beam Sweep Magnifier Registration

a. Set the Upper Beam DISPLAY MAG switch to ×10 and position the start of the trace to the graticule center vertical line.

b. Change the DISPLAY MAG switch to ×1.

c. Check—No shift of the start of the trace as the DISPLAY MAG switch is changed from ×10 to ×1.

d. Adjust R1168 (Fig. 6-34) to position the start of the trace to the graticule center line.

e. Repeat steps (a) through (d) until there is no shift of the start of the trace as the DISPLAY MAG switch is changed from ×10 to ×1.

f. Check that the Lower Beam DISPLAY MAG switch is set to ×1.

38. Adjust A Sweep Sawtooth Amplitude

a. Set the time-mark generator for 1-millisecond and 500-microsecond markers. Position the display to start at the 0-cm graticule line.

b. Check—The 22nd marker (counting the marker at the 0-cm graticule line) is just visible at the right hand edge of the graticule.

c. Adjust R678 (see Fig. 6-33) so that the trace ends as the 22nd marker becomes visible. The sweep length is 10.5 cm.

d. Return the DISPLAY MAG switch to ×10.

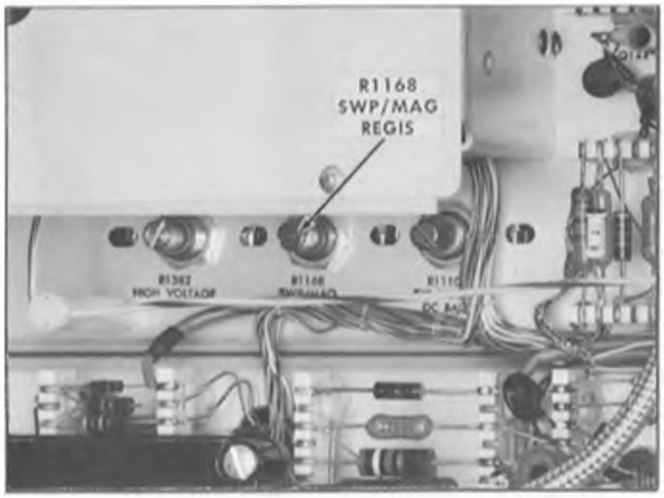


Fig. 6-34. Adjustment location for Upper Beam sweep magnifier registration.

39. Adjust B Sweep Sawtooth Slope

a. Set the Upper Beam DISPLAY switch to LEFT PLUG-IN B.

b. Set the time-mark generator for 1-millisecond and 100-microsecond markers.

c. Check—One 100-microsecond marker/cm on the Upper Beam display.

d. Adjust R861 (see Fig. 6-35) for one 100-microsecond marker/cm.

e. Return the DISPLAY MAG switch to ×1.

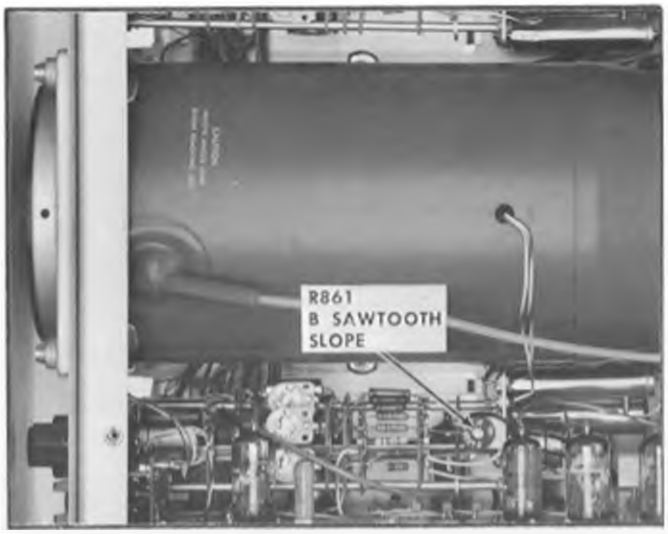


Fig. 6-35. Adjustment location for B sweep sawtooth slope.

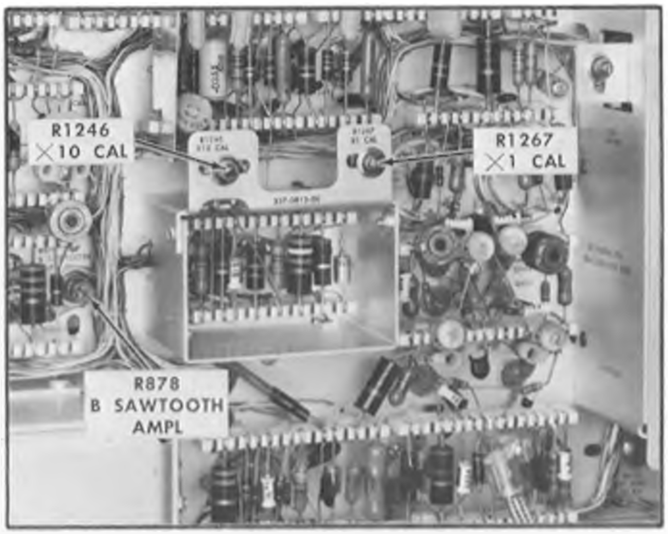


Fig. 6-36. Adjustment location for basic timing and B sweep amplitude.

40. Adjust B Sweep Sawtooth Amplitude

a. Set the time-mark generator for 1-millisecond and 500-microsecond markers.

b. Check—The 22nd marker (counting the marker at the 0-cm graticule line) is just visible at the right-hand edge of the graticule.

c. Adjust B Sawtooth Amplitude control R878 (see Fig. 6-36) so the trace ends as the 22nd marker becomes visible (sweep length is 10.5 cm).

41. Adjust Basic Timing—B Sweep

a. Set the Lower Beam DISPLAY switch to ×10, and position the display for optimum viewing.

b. Set the time-mark generator for 1-millisecond and 100-microsecond markers.

c. Check—One 100-microsecond marker/cm.

d. Adjust R1246 (see Fig. 6-36) to obtain one 100-microsecond marker/cm.

e. Change the Lower Beam DISPLAY MAG switch to ×1.

f. Check—One 1-millisecond marker/cm.

g. Adjust R1267 to obtain one 1-millisecond marker/cm. R1267 is located on the same bracket adjacent to the ×10 adjustment (see Fig. 6-36).

h. Interaction—Repeat steps (a) through (g) for accurate adjustment as necessary.

42. Adjust Lower Beam Sweep Magnifier Registration

a. Set the Lower Beam DISPLAY MAG switch to ×10 and position the start of the trace to the graticule center vertical line.

b. Change the DISPLAY MAG switch to ×1.

c. Check—No shift of the start of the trace as the DISPLAY MAG switch is changed from ×10 to ×1.

d. Adjust R1268 SWP/MAG REGIS (see Fig. 6-53) to position the start of the trace to the graticule center line.

e. Repeat steps (a) through (d) until there is no shift of the start of the trace as the DISPLAY MAG switch is changed from ×10 to ×1.

f. Return the DISPLAY MAG switch to ×1 and disconnect the time-markers from the Type 556.

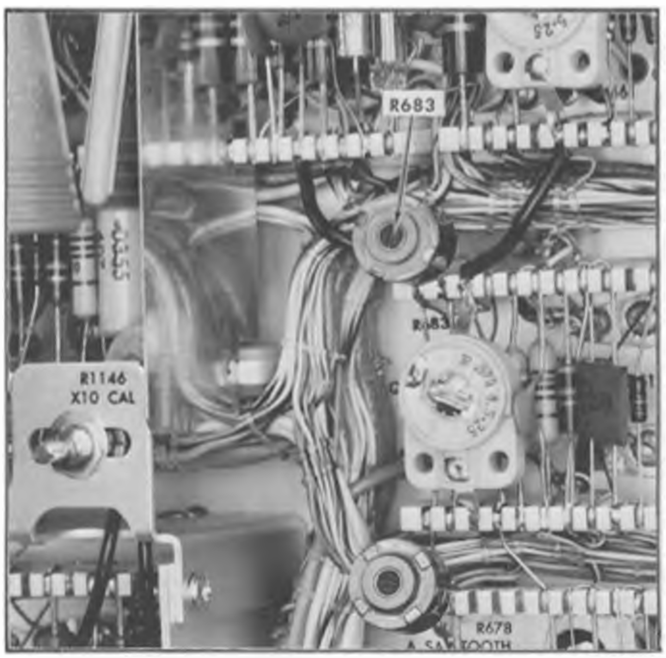


Fig. 6-37. Location of lower beam A sweep gain adjustment for serial numbered instruments 2000 and up.

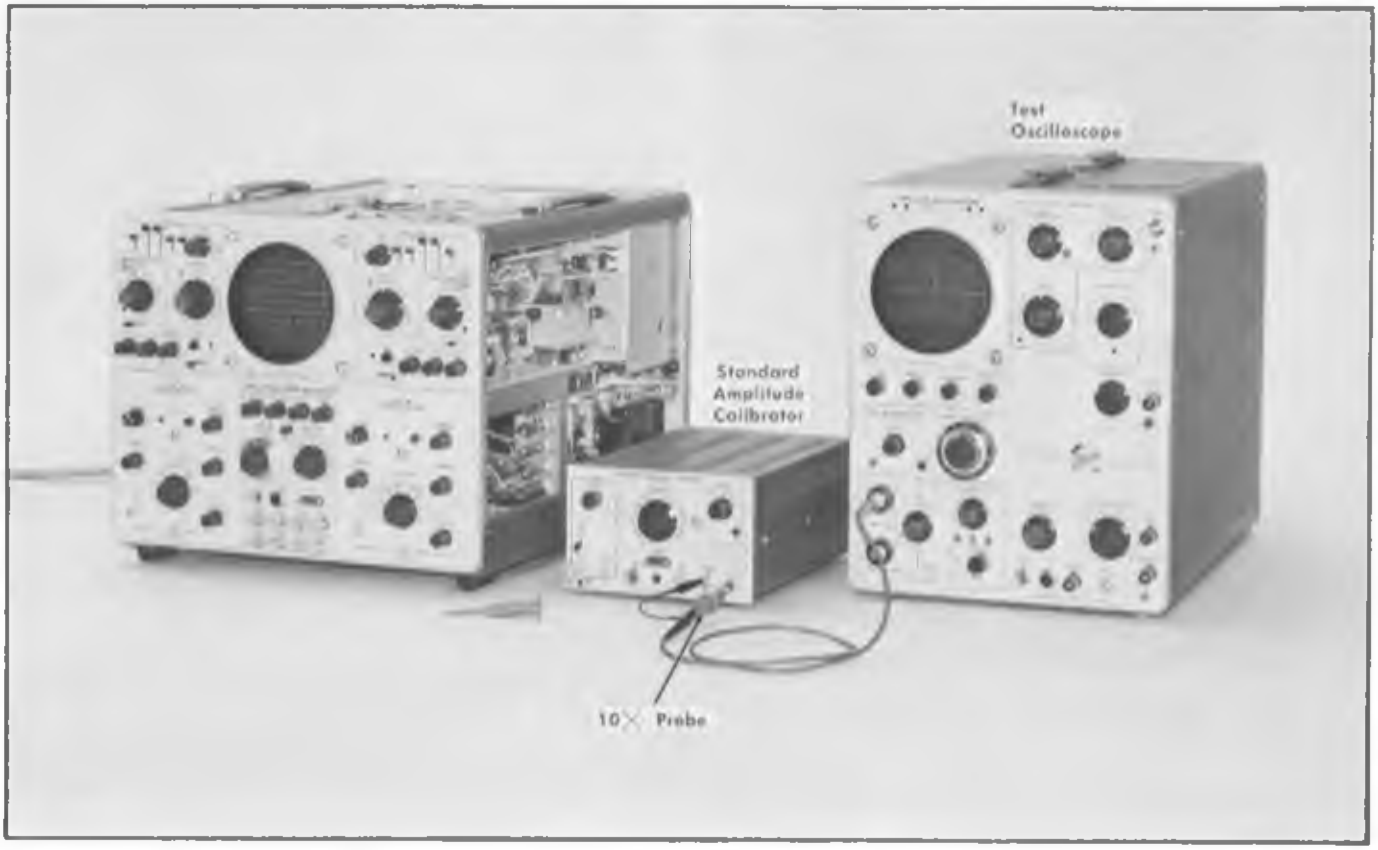


Fig. 6-38. Equipment setup for A and B sawtooth current adjust.

43. Adjust Lower Beam A Sweep Gain (SN2000-up only)

a. Set the Upper Beam DISPLAY switch to LEFT PLUG-IN A.

b. Set the A TIME/CM switch to 1 mSEC.

c. Set the Lower Beam DISPLAY switch to A.

d. Set the Lower Beam DISPLAY MAG switch to ×10.

e. Check—One 100-microsecond marker/cm.

f. Adjust R683 (see Fig. 6-37) to obtain one 100-microsecond marker/cm.

44. Adjust A and B Sawtooth Currents

a. The equipment setup is shown in Fig. 6-38.

b. Set the Standard Amplitude Calibrator for a 2-volt square-wave output signal.

c. Set the test oscilloscope/plug-in vertical deflection switch to 0.05 volts/cm.

d. Set the test oscilloscope Time/Cm switch to 1 millisecond/cm.

e. Connect the 10× Probe tip to the Standard Calibrator Output and if necessary, adjust the test oscilloscope variable volts/cm for a deflection of exactly 4 cm.

f. Remove the probe tip from the Standard Calibrator connector and connect it to the junction of R685 and the A SAWTOOTH CURRENT adjustment R684 (see Fig. 6-39A).

g. Set the test oscilloscope Time/Cm switch to 5 mSEC.

h. Check—Display amplitude of 4 cm.

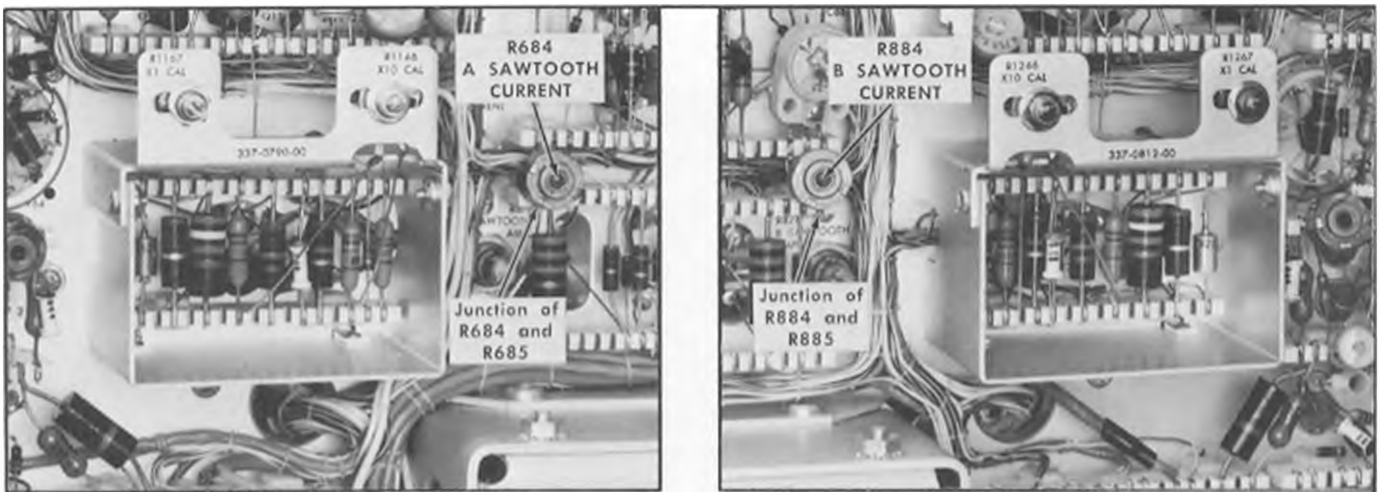
i. Adjust R684 for a 4-cm display on the test oscilloscope. It may be necessary to change the A TIME/CM switch to a sweep rate which will display several sawtooth cycles for a more convenient amplitude measurement. See Fig. 6-39A for R684 location.

j. Change the probe from the junction of R684 and R685 to the junction point for R885 and B SAWTOOTH CURRENT adjustment R884 (see Fig. 6-39B).

k. Check—Display amplitude of 4 cm.

l. Adjust R884 (see Fig. 6-39B) for a 4-cm display on the test oscilloscope.

m. Remove the probe.



(A) A sawtooth current adjustment and test point location (left side)

(B) B sawtooth current adjustment and test point location (right side)

Fig. 6-39. A and B sawtooth current adjustment and test point locations.

45. Check Delay-Time Multiplier Dial Setting

a. Rotate the DELAY-TIME MULTIPLIER dial fully counterclockwise until it hits the stop.

NOTE

If dial is reset, delayed-sweep calibration will be changed and it will be necessary to perform a recalibration of the A sweep, which follows in steps 46 through 49.

b. Check—Dial reading of 0.20, ±2 minor divisions.

c. If the dial reading is not 0.20 (within ±2 minor divisions), loosen the knob setscrew and reposition the knob so that the fully counterclockwise position reading is correct.

d. Rotate the DELAY-TIME MULTIPLIER dial fully clockwise.

e. Check—Dial reading of 10.20, ±4 minor divisions.

NOTES

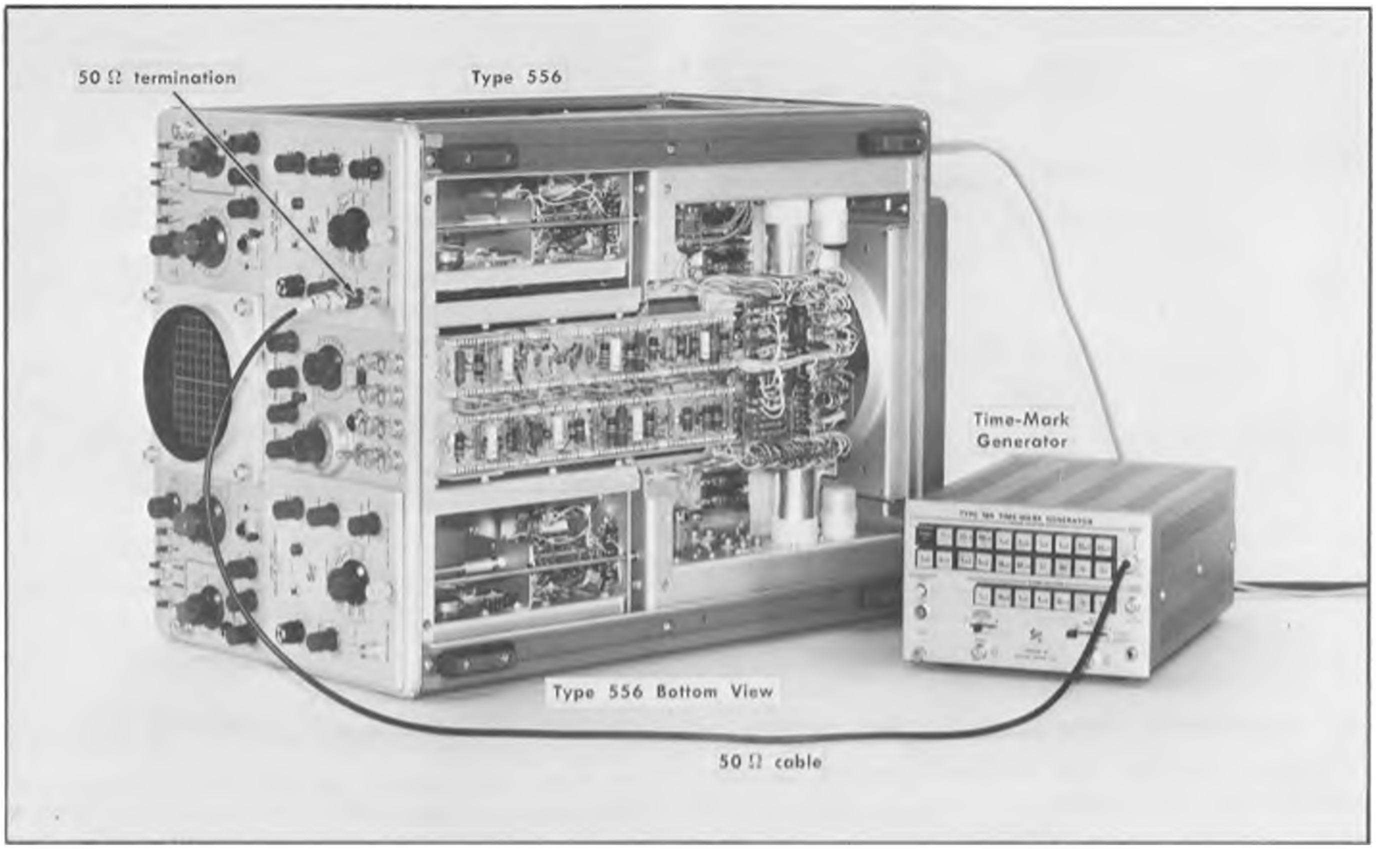


Fig. 6-40. Test setup for adjusting Delay Start and Stop.

46. Adjust Delay Start and Stop

a. The test setup is shown in Fig. 6-40.

b. Set controls as follows:

A Triggering Controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Near 0, knob pushed in
Upper Beam DISPLAY	RIGHT PLUG-IN A
Upper Beam DISPLAY MAG	×1
A TIME/CM	1 mSEC
A VARIABLE	CALIBRATED
A MODE	NORM
B Triggering Controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Fully clockwise, knob pulled outward
Lower Beam DISPLAY	RIGHT PLUG-IN B
Lower Beam DISPLAY MAG	×1
B TIME/CM	10 μSEC
B VARIABLE	CALIBRATED
B MODE	NORM
Test Load Units (both)	
Test Function	Low Load

c. Connect a 50 Ω cable from the time-mark generator through a 50 Ω termination to the right test load unit Ext Input connector.

d. Set the time-mark generator for 1-millisecond markers.

e. Adjust the A Triggering controls for a stable display on the Upper Beam.

f. Adjust the TRACE SEPARATION and right test load unit Variable and Vertical Position controls for convenient viewing of the Upper and Lower Beam displays.

g. Change the B MODE switch to DLY'D BY A.

h. Set the DELAY-TIME MULTIPLIER dial to 1.00.

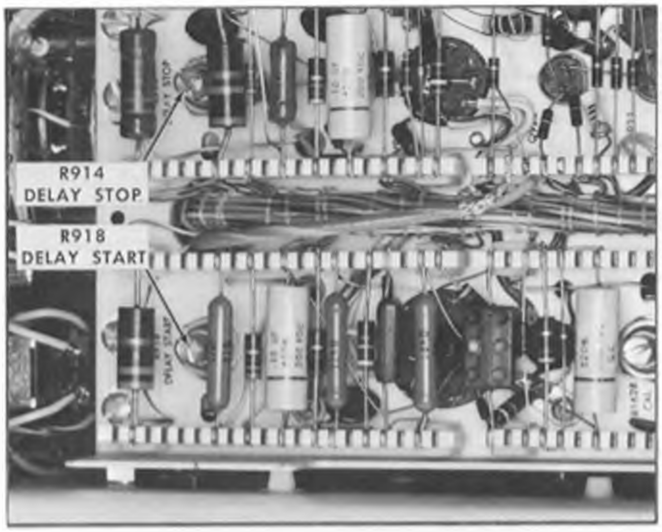


Fig. 6-41. Delay Start and Stop Adjust locations.

NOTE

Adjustment of the Upper Beam INTENSITY and CONTRAST controls may be necessary for optimum viewing of the intetnsified portion of the display.

i. Check—Intensified portion of the Upper Beam display starts at the 2nd marker (see Fig. 6-42A).

j. Adjust DELAY START R918 (Fig. 6-41) so that the intensified portion of the display starts at the 2nd marker (preliminary adjustment).

k. Set the DELAY-TIME MULTIPLIER dial to 9.00.

l. Check—Intensified portion of display starts at the 10th marker (see Fig. 6-42B).

m. Adjust DELAY STOP R914 (see Fig. 6-41) so that the intensified portion of the display starts at the 10th marker.

n. Set the DELAY-TIME MULTIPLIER dial to 1.00.

o. Check—The rising portion of the delayed pulse (displayed on Lower Beam) starts at the 0-cm graticule line.

p. Readjust DELAY START R918 so that the rising portion of the delayed pulse starts at the 0-cm graticule line.

q. Set the DELAY-TIME MULTIPLIER dial to 9.00.

r. Check—The rising portion of the delayed pulse starts at the 0-cm graticule line.

s. Readjust DELAY STOP R914 so that the rising portion of the delayed pulse starts at the 0-cm graticule line.

t. Interaction—Repeat steps (n) through (s) and readjust if necessary.

47. Check Delay-Time Multiplier Incremental Linearity

a. Set the DELAY-TIME MULTIPLIER dial to 8.00.

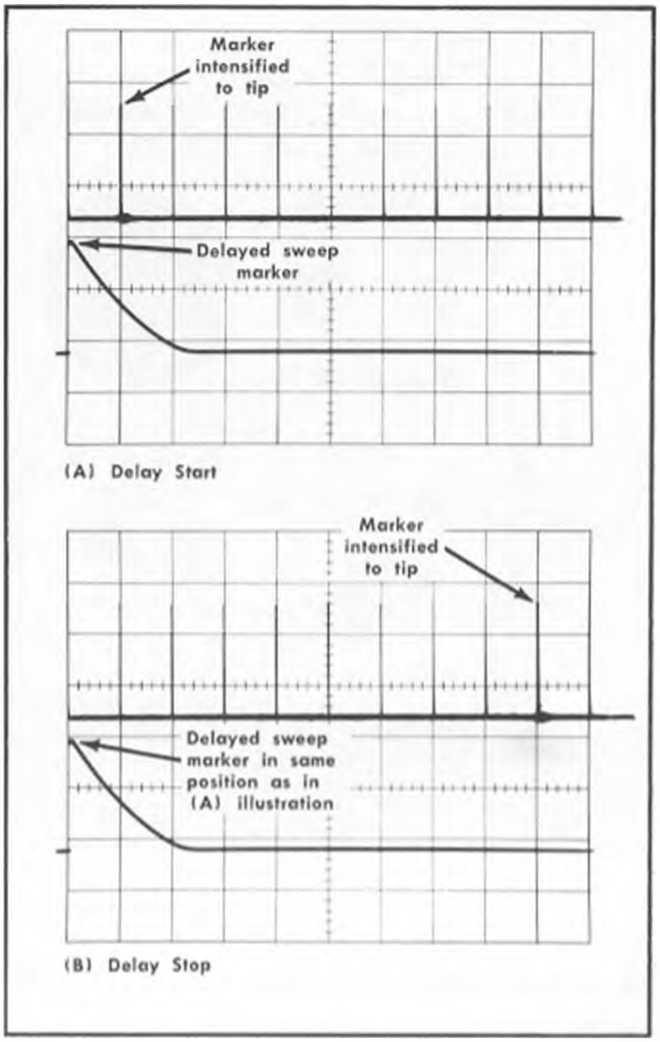


Fig. 6-42. Typical displays, Delay Start and Stop adjustments.

b. Rotate the dial as necessary to position the delayed pulse to start at the 0-cm graticule line.

c. Check—Deviation of dial reading from 8.00 should be not more than ±2 minor divisions of the dial.

d. Repeat check at all major dial divisions from 8.00 to 1.00.

48. Check Delay-Time Jitter

a. Change the B TIME/CM switch to 1 μSEC.

b. Set the DELAY-TIME MULTIPLIER dial to 10.00 approximately, centering the magnified pulse near the center of the graticule.

c. Check—Jitter not more than 0.5 cm.

d. Set the DELAY-TIME MULTIPLIER dial to 1.00 approximately, centering the magnified waveform near the center of the graticule.

e. Check—Jitter not more than 0.5 cm.

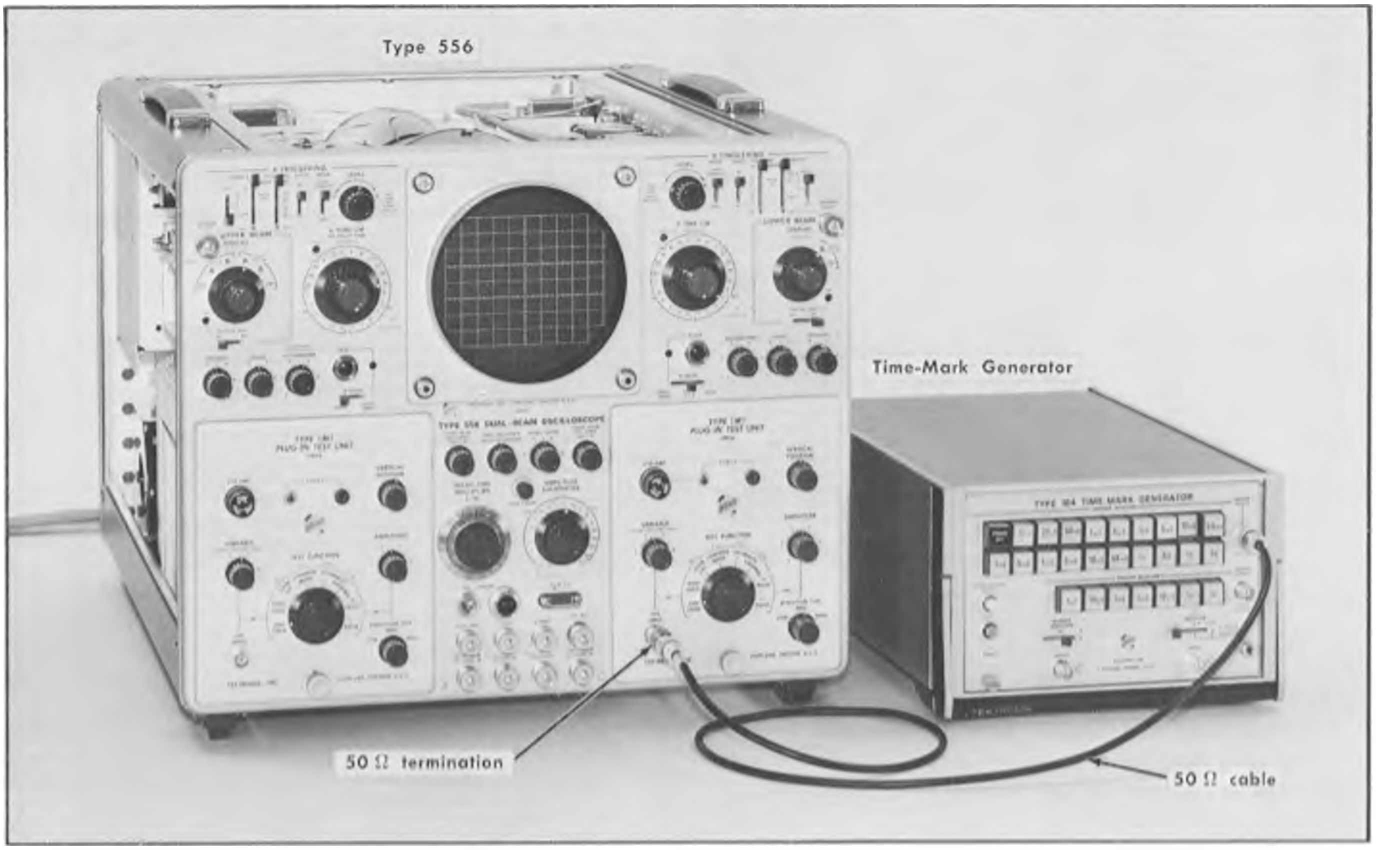


Fig. 6-43. Test setup for Sweep Timing—A and B.

49. Adjust Timing—A Sweep

a. The test setup is shown in Fig. 6-43.

b. Set controls as follows:

A Triggering Controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Near 0, knob pushed in
Upper Beam DISPLAY	RIGHT PLUG-IN A
Upper Beam DISPLAY MAG	×1
A TIME/CM	10 μSEC
A VARIABLE	CALIBRATED
A MODE	NORM
B Triggering Controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Fully clockwise, knob pulled outward
Lower Beam DISPLAY	RIGHT PLUG-IN B
Lower Beam DISPLAY MAG	×1
B TIME/CM	1 μSEC
B VARIABLE	CALIBRATED
B MODE	DLY'D BY A
DELAY-TIME MULTIPLIER	1.00
Test Load Unit (both)	
Test Function	Low Load
Time-Mark Generator	10 microseconds

NOTE

Throughout the timing procedure the delayed sweep display on the Lower Beam is used as an aid in making accurate timing adjustments. Fig. 6-44 illustrates the correct method of positioning the delayed sweep display in relation to the delaying or A sweep. The use of a consistent method of positioning will result in a high degree of timing accuracy.

c. Set the time-mark generator for 10-microsecond marker output and adjust the Type 556 A Triggering controls for a stable display.

d. Adjust the CONTRAST and INTENSITY controls so that the intensified portion of the Upper Beam display can be easily distinguished from the rest of the display.

e. Set the DELAY-TIME MULTIPLIER dial so that the 2nd marker on the Upper Beam display is fully intensified to the marker tip, similar to the waveform shown in Fig. 6-44. The dial reading will be on or near 1.00; note the reading. Also note the position of the Lower Beam display markers.

f. Rotate the DELAY-TIME MULTIPLIER dial to move the intensified portion of the display to the 10th marker, and set the dial to read 8.00 divisions plus the reading noted in step (e).

Example: if the dial reading in step (e) is 1.03, the new setting should be 9.03 exactly.

g. Check—The 10th marker is intensified to the marker tip, similar to the waveform shown in Fig. 6-44.

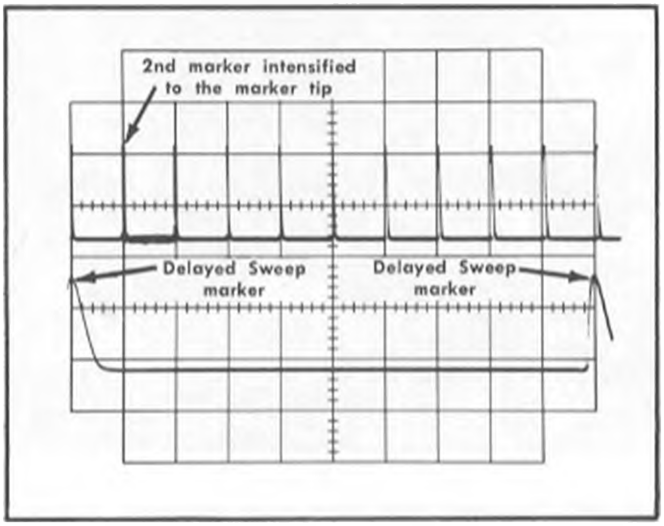


Fig. 6-44. Method of adjusting timing as described in step 49 (e).

h. Adjust C660G (Fig. 6-45) so that the 10th marker is fully intensified, and the Lower Beam display markers are positioned as in step (g).

i. Interaction—Repeat steps (e), (f), (g), and (h) as needed.

j. Change the A TIME/CM switch to 1 μSEC, and the B TIME/CM to 0.1 μSEC. Set the time-mark generator for 1-microsecond marker output.

k. Repeat steps (e and f).

l. Check—The tenth marker is intensified to the marker tip.

m. Adjust C660H (Fig. 6-45) so that the tenth marker is intensified to the marker tip, and the delayed sweep display is positioned the same as in the 1.00 setting of the DELAY TIME MULTIPLIER dial.

n. Interaction—Repeat the check at the 1.00 dial setting and the adjustment at the 9.00 dial setting until no further adjustment is necessary.

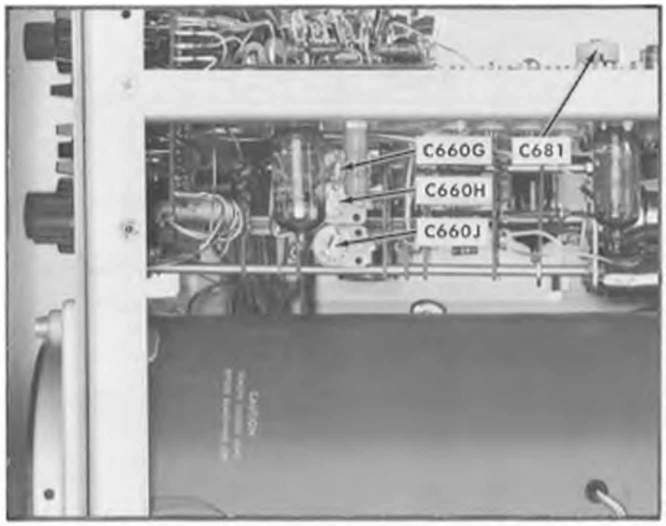


Fig. 6-45. Adjustment locations for A sweep timing, top view of Type 556.

o. Connect a 10-microsecond trigger signal from the time-mark generator Trigger Output connector through a 50-ohm cable and 50-ohm termination to the Upper Beam TRIGGER INPUT connector and set the A triggering SOURCE switch to EXT.

p. Change the A TIME/CM switch to 0.5 μSEC and check that the time-mark generator is set to supply 1-microsecond marker output to the right plug-in.

q. Check—One 1 μSEC marker per 2 cm (disregard the first marker.)

r. Preadjust C660J (Fig. 6-45) for one 1 μSEC marker/2 cm.

s. Change the A TIME/CM switch to 0.1 μSEC and the time-mark generator to supply 0.1-microsecond markers.

t. Check—One marker per cm, Upper Beam display.

u. Preadjust C861 (Fig. 6-45) for one marker/cm.

v. Interaction—C660J and C681 adjustments interact; repeat steps (p) through (u) as necessary.

w. Set the DELAY TIME MULTIPLIER dial to 1.00.

x. Adjust the CONTRAST control so the intensified portion of the Upper Beam display can be viewed. Use the Upper Beam POSITION control to position the peak of the first intensified pulse to the 1-cm vertical graticule line.

y. Set the Lower Beam DISPLAY MAG switch to ×10 and use the Lower Beam POSITION control to position the 50% level on the rising portion of the marker pulse to an intercept point. For example, at the point where 5th cm vertical graticule line and 2nd cm horizontal line from bottom of graticule meet as shown in Fig. 6-46.

z. Set the dial to 9.00, but, while doing so, be sure to count eight markers (not counting the one displayed at 1.00) displayed by the Lower Beam as these markers move to the left past the intercept point. Then, as the dial is set to 9.00, the 50% level on the rising portion of the eighth marker should be at the intercept point.

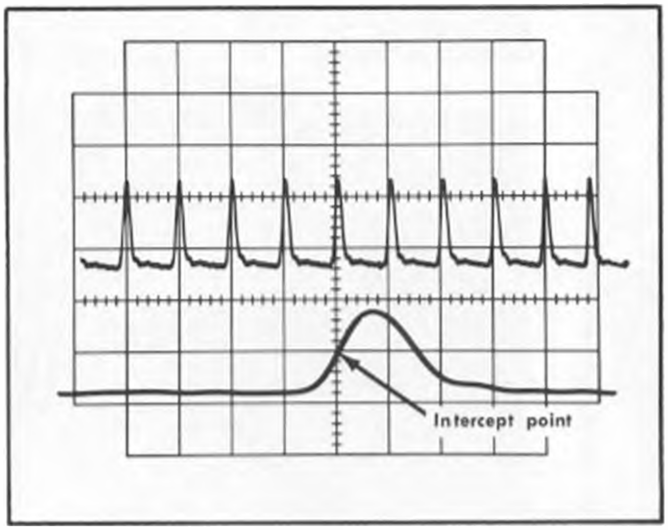


Fig. 6-46. Typical display obtained to illustrate intercept point with dial at 1.00.

aa. Check—8th marker at intercept point.

ab. Readjust C660J (Fig. 6-45) to position the eighth marker at the intercept point.

ac. Change CONTRAST control and, if desired, the INTENSITY control so all of the Upper Beam display is visible. Reposition the Upper Beam display so the 2nd marker is located at the 1-cm vertical graticule line.

ad. Check—One marker/cm, Upper Beam display.

ae. Readjust C681 (Fig. 6-45) for one marker per cm.

NOTE

If the linearity from the 1st to 2nd marker is exceedingly poor, check the position of the slugs in C1174 and C1184 (Fig. 6-47). The slugs should normally be positioned about five turns above the metal wiper contacts. If the slugs are readjusted so they are five turns out, repeat step (ae).

50. Adjust Horizontal Amplifier 50 MHz Compensation—Upper Beam

a. Change the B MODE switch to SINGLE SWEEP (this disables the B sweep.)

b. Set the time-mark generator for 50 MHz (20 ns) sine wave output.

c. Change the Upper Beam DISPLAY MAG switch to ×10.

d. Position the sine waves to align with the vertical graticule lines.

e. Check—One cycle/2 cm, Upper Beam display.

f. Adjust C1193 (see Fig. 6-47) for maximum sweep expansion.

g. Adjust C1182 (see Fig. 6-47) for maximum sweep expansion.

h. Adjust C1172 (see Fig. 6-47) for maximum sweep expansion.

i. Repeat steps (f) through (h) in the same order.

j. Position the display so the Upper Beam waveform starts at the 0-cm graticule line. Turn up the INTENSITY control temporarily to check that the waveform is properly positioned. See Fig. 6-48A.

k. Adjust the A Triggering LEVEL control so a sine-wave peak (top or bottom) falls on the 4-cm graticule line. Note that sine-wave peak and position it to the 1-cm graticule line. (See Fig. 6-48B).

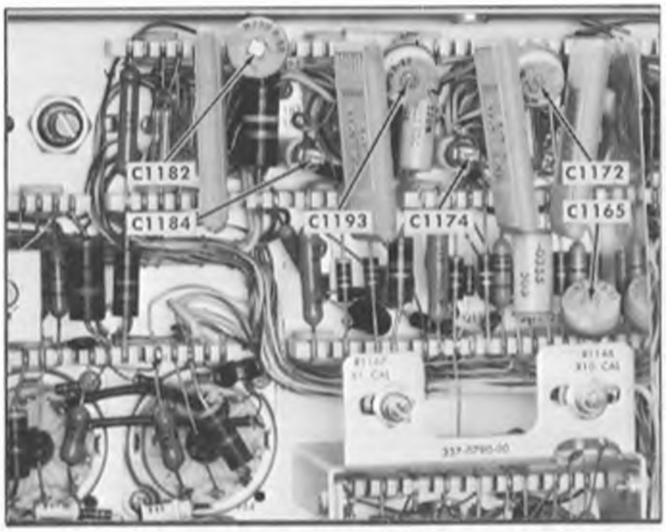


Fig. 6-47. High-speed sweep compensation adjustment, A sweep.

l. Check—One cycle/2 cm, Upper Beam display; 1-cm, 5-cm and 9-cm sine-wave peaks should coincide with their respective graticule lines (see Fig. 6-48C). Tolerance is ±5% or ±4 mm.

m. Adjust C1165 (see Fig. 6-47) for 1 cycle/2 cm and so the sine-wave peaks at the 1-cm and 9-cm locations coincide with their respective graticule lines.

n. If the center sine-wave peak does not coincide with the 5-cm graticule line, readjust C1174 and C1184 until proper coincidence of 1-cm and 5-cm peaks is obtained.

o. Readjust C1165 until the 1-cm and 9-cm sine-wave peaks coincide with their respective graticule lines.

p. If C1165 is readjusted, repeat steps (n) and (l) for proper linearity of sine-wave peak alignment with the 1-cm, 5-cm and 9-cm graticule lines (see Fig. 6-48C).

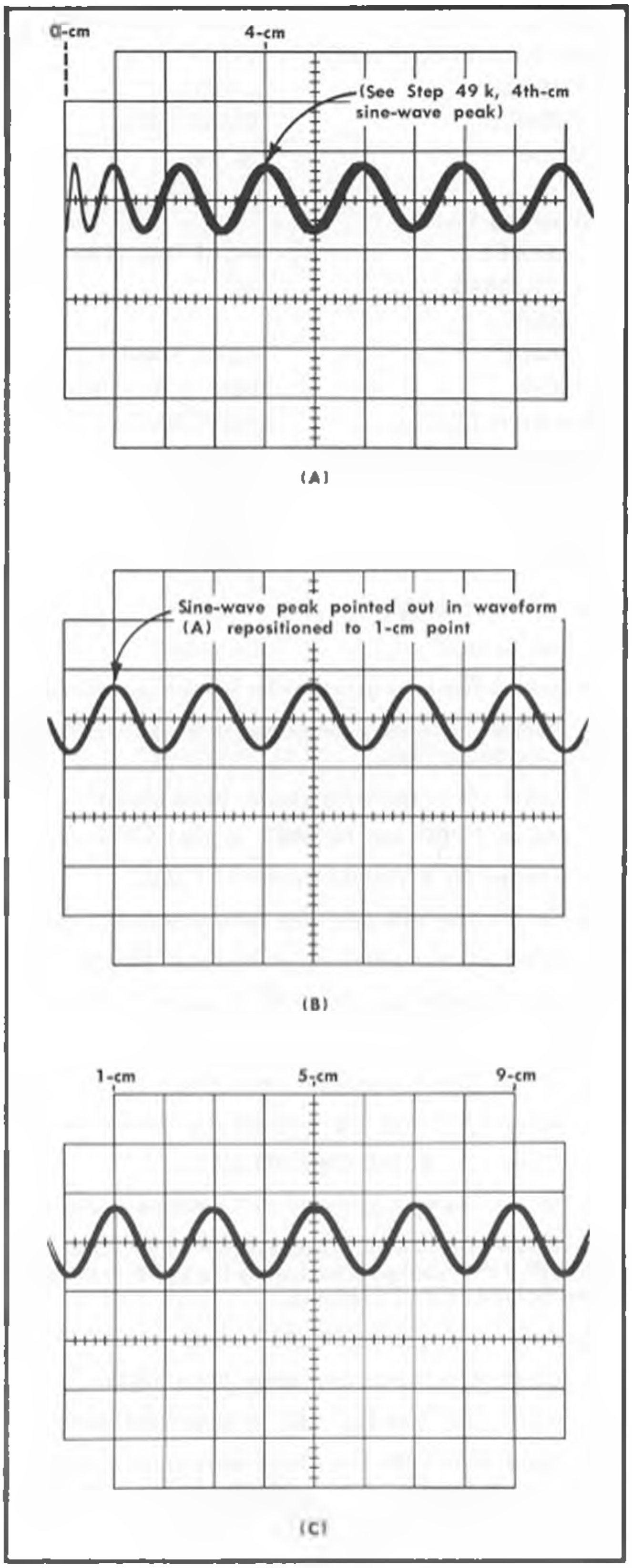


Fig. 6-48. Typical displays, high-speed sweep timing. Waveform (A) shows top peak of a sine wave at the 4-cm graticule line, waveform (B) shows display properly positioned, and waveform (C) shows correct high-speed sweep timing and linearity.

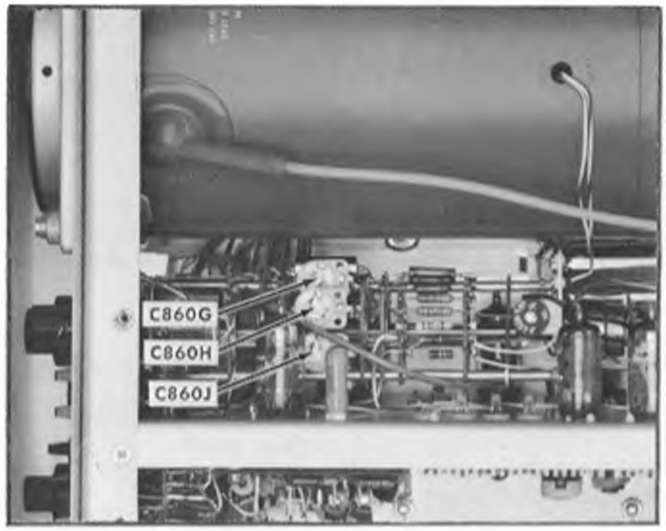


Fig. 6-49. Adjustment locations for B sweep timing, top view of Type 556.

q. Change the Upper Beam DISPLAY MAG switch to ×1.

r. Reposition the Upper Beam display to start at the 0-cm graticule lines.

s. Change the Upper Beam DISPLAY MAG switch to ×10.

t. Check—One cycle/2 cm, Upper Beam display. The 1-cm and 9-cm sine-wave peaks should coincide with their respective graticule lines. Tolerance is ±5% or ±4 mm.

u. If the 9-cm sine-wave peak falls long with respect to the graticule line, readjust C1172 for proper timing. If the 9-cm sine-wave peak falls short, repeat steps (f) through (t). If the sweep timing is correct, position the display 10 cycles to the left. Repeat step (t) and then go to step (v).

v. Change the Upper Beam DISPLAY MAG switch to ×1 and reposition the display to start at the 0-cm graticule line.

w. Set the time-mark generator for 0.1-microsecond marker output.

x. Check—One marker/cm, Upper Beam display.

y. Readjust C681 for one marker/cm.

51. Check Timing and Delaying Sweep Accuracy —A Sweep

a. Change the B MODE switch to DLY'D BY A, and check that the Lower Beam DISPLAY switch is set to ×10.

b. Check—Using Table 6-3 as a guide, check the A Sweep CRT displayed accuracy with respect to the 1-cm and 9-cm graticule lines. Tolerance should be within ±3% or ±2.4 mm. In addition, check the delayed sweep accuracy using the DELAY-TIME MULTIPLIER dial. Tolerance should be within 8 minor divisions for each A TIME/CM switch position. The technique for checking the three fastest sweep rates using the DELAY-TIME MULTIPLIER dial is as follows:

For the 0.1 μSEC A TIME/CM switch position, the basic technique is described in steps 49s through 49aa. For the 0.2 μSEC switch position the technique is similar to the 0.1 position, but 16 markers must be counted on the Lower Beam display when rotating the dial from 1.00 to 9.00. Check dial reading from 9.00 at intercept point. For the 0.5 μSEC switch position, set the A Triggering SOURCE switch to RIGHT INT NORM, the Lower Beam DISPLAY MAG switch to ×1 and use a similar technique to that described in steps 49c through 49f.

For the A TIME/CM switch position from 1 μSEC to 5 SEC, use a similar technique for checking delaying sweep accuracy to that used when setting up the Delay Start and Stop adjustments (step 46) and as shown in Fig. 6-43.

TABLE 6-3

Timing and Delaying Sweep Accuracy—A Sweep

A TIME/CM	B TIME/CM	Time Mark Generator	Check Upper Beam Display[2]
0.1 μSEC[3]	0.1 μSEC[4]	0.1 μs	1 marker/cm
0.2 μSEC	0.1 μSEC[4]	0.1 μs	2 markers/cm
0.5 μSEC[5]	0.1 μSEC	0.5 μs	1 marker/cm
1 μSEC[3]	0.1 μSEC	1 μs	1 marker/cm
2 μSEC	0.2 μSEC	1 μs	2 markers/cm
5 μSEC	0.5 μSEC	5 μs	1 marker/cm
10 μSEC[3]	1 μSEC	10 μs	1 marker/cm
20 μSEC	2 μSEC	10 μs	2 markers/cm
50 μSEC	5 μSEC	50 μs	1 marker/cm
0.1 mSEC	10 μSEC	0.1 ms	1 marker/cm
0.2 mSEC	20 μSEC	0.1 ms	2 markers/cm
0.5 mSEC	50 μSEC	0.5 ms	1 marker/cm
1 mSEC[3]	0.1 mSEC	1 ms	1 marker/cm
2 mSEC	0.2 mSEC	1 ms	2 markers/cm
5 mSEC	0.5 mSEC	5 ms	1 marker/cm
10 mSEC	1 mSEC	10 ms	1 marker/cm
20 mSEC	2 mSEC	10 ms	2 markers/cm
50 mSEC	5 mSEC	50 ms	1 marker/cm
0.1 SEC	10 mSEC	0.1 s	1 marker/cm
0.2 SEC	20 mSEC	0.1 s	2 markers/cm
0.5 SEC	50 mSEC	0.5 s	1 marker/cm
1 SEC	0.1 SEC	1 s	1 marker/cm
2 SEC	0.2 SEC	1 s	2 markers/cm
5 SEC	0.5 SEC	5 s	1 marker/cm

[2]Use CONTRAST control to check display.

[3]Previously adjusted.

[4]Lower Beam DISPLAY MAG switch is set to ×10. (For the remaining B TIME/CM switch positions, the switch is set to ×1.)

[5]Previously adjusted. Set the A Triggering SOURCE switch to RIGHT INT NORM and the MODE switch to TRIG.

52. Adjust Timing—B Sweep

a. Set the Type 556 and plug-in controls as follows:

A Triggering Controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	TRIG
LEVEL	Fully clockwise, knob pushed in
Upper Beam DISPLAY	RIGHT PLUG-IN A
Upper Beam DISPLAY MAG	×1
A TIME/CM	1 mSEC
A VARIABLE	CALIBRATED
A MODE	NORM
B Triggering Controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Near 0, knob pushed in
Lower Beam DISPLAY	RIGHT PLUG-IN B
Lower Beam DISPLAY MAG	×1
B TIME/CM	10 μSEC
B VARIABLE	CALIBRATED
B MODE	NORM
Test Load Unit (both)	
Test Function	Low Load

b. Set the time mark generator for 10-microsecond markers.

c. Position the Lower Beam display so the markers coincide with the graticule lines.

d. Check—One marker/cm, Lower Beam display.

e. Adjust C860G (see Fig. 6-49) to obtain 1 marker/cm.

f. Change the B TIME/CM switch to 1 μSEC.

g. Set the time-mark generator for 1-microsecond markers.

h. Check—One marker/cm, Lower Beam display.

i. Adjust C860H (see Fig. 6-49) to obtain 1 marker/cm.

j. Change the B TIME/CM switch to 0.5 μSEC.

k. Check—One marker/2 cm, Lower Beam display.

l. Adjust C860J (see Fig. 6-49) for one marker per 2 cm.

m. Change the B TIME/CM to 0.1 μSEC.

n. Set the time-mark generator for 0.1-microsecond markers.

o. Remove the 10 μSEC trigger signal from the Upper Beam TRIGGER INPUT connector and apply the signal to the Lower Beam TRIGGER INPUT connector.

p. Set the B Triggering SOURCE switch to RIGHT EXT.

q. Check—One marker/cm, Lower Beam display.

r. Adjust C881 (see Fig. 6-50) to obtain one marker/cm.

s. Interaction—C881 and C860J adjustments interact; set the time-mark generator for 1-microsecond markers and repeat steps (j) through (r) until no further adjustment is necessary.

53. Adjust C882—B Sweep Crossover Compensation

a. Change the Upper Beam DISPLAY switch to RIGHT PLUG-IN B.

b. Check—One marker/cm, Upper Beam display.

c. Adjust C882 (see Fig. 6-50) for one marker/cm on the Upper Beam display.

54. Adjust Horizontal Amplifier 50 MHz Compensation-Lower Beam

a. Change the Upper Beam DISPLAY switch to LEFT PLUG-IN A.

b. Set the time mark generator for 50 MHz (20 ns) sine-wave output.

c. Change the Lower Beam DISPLAY MAG switch to ×10.

d. Position the sine waves to align with the vertical graticule lines.

e. Check—One cycle/2 cm, Lower Beam display.

f. Adjust C1293 (see Fig. 6-50) for maximum sweep expansion.

g. Adjust C1282 (see Fig. 6-50) for maximum sweep expansion.

h. Adjust C1272 (see Fig. 6-50) for maximum sweep expansion.

i. Repeat steps (f) through (h) in the same order.

j. Position the display so the Lower Beam waveform starts at the 0-cm graticule line. (Turn up the INTENSITY control temporarily to check that the waveform is properly positioned. Use Fig. 6-48A as aguide).

k. Adjust the B Triggering LEVEL control so a sine-wave peak (top or bottom) falls on the 4-cm graticule line. Note that sine-wave peak and position it to the 1-cm graticule line. (Use Fig. 6-48B as aguide).

l. Check—One cycle/2 cm, Lower Beam display; 1-cm, 5-cm and 9-cm sine-wave peaks should coincide with their respective graticule lines. Tolerance is ±5% or ±4 mm.

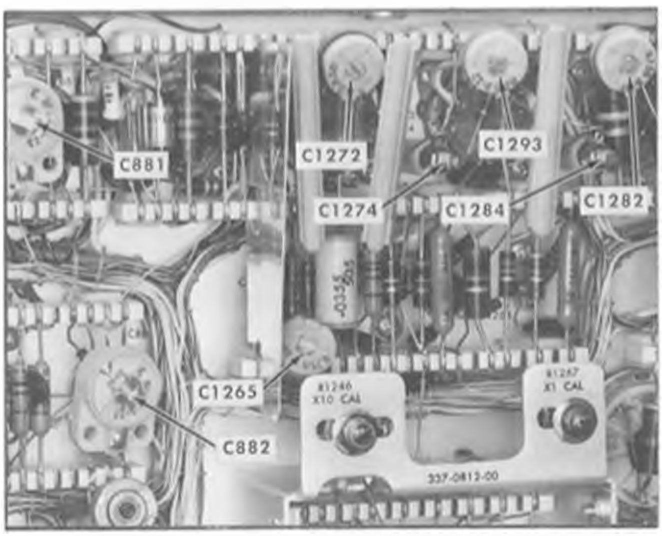


Fig. 6-50. High-speed sweep compensation adjustments—B sweep.

m. Adjust C1265 (see Fig. 6-50) for 1 cycle/2 cm and so the sine-waves peaks at 1-cm and 9-cm locations coincide with their respective graticule lines.

n. If the center sine-wave peak does not coincide with the 5-cm graticule line, readjust C1274 and C1284 until proper coincidence of 1-cm and 5-cm peaks is obtained.

o. Readjust C1265 until the 1-cm and 9-cm sine-wave peaks coincide with their respective graticule lines.

p. If C1265 is readjusted, repeat steps (n) and (o) for proper linearity of sine-wave peak alignment with the 1-cm, 5-cm and 9-cm graticule lines (Use Fig. 6-48C as a guide.)

q. Change the Lower Beam DISPLAY MAG switch to ×1.

r. Reposition the Lower Beam display to start at the 0-cm graticule line.

s. Change the Lower Beam DISPLAY MAG switch to ×10.

t. Check—One cycle/2 cm, Lower Beam display. The 1-cm and 9-cm sine-wave peaks should coincide with their respective graticule lines. Tolerance is ±5% or ±4 mm.

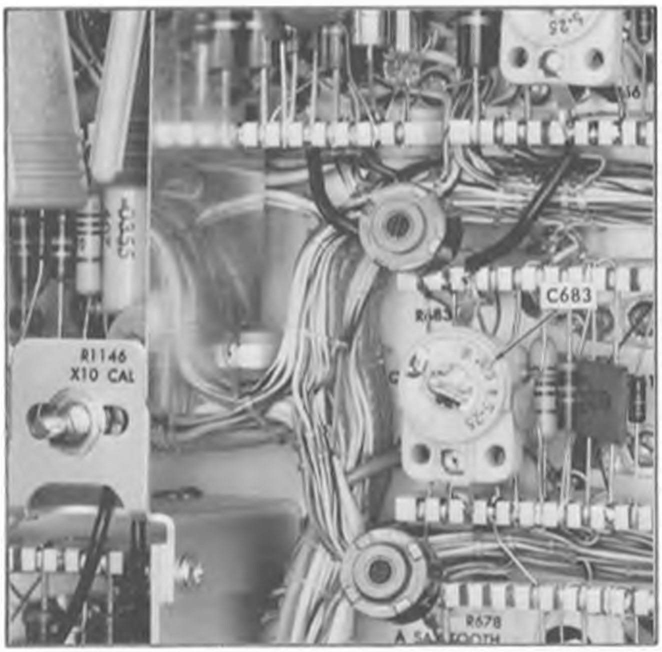


Fig. 6-51. Location of sweep crossover adjustment for serial numbered instruments 2000 and up.

u. If the 9-cm sine-wave falls long with respect to the graticule line, readjust C1272 for proper timing. If the 9-cm sine-wave peak falls short, repeat steps (f) through (t). If the sweep timing is correct, position the display 10 cycles to the left. Repeat step (t) and then go to step (v).

v. Change the Lower Beam DISPLAY MAG switch to ×1 and reposition the display to start at the 0-cm graticule line.

w. Set the time-mark generator for 0.1-microsecond marker output.

x. Check—One marker/cm, Lower Beam display.

y. Readjust C881 for one marker/cm.

55. Adjust—A Sweep Crossover Compensation (SN 2000-up only)

a. Set the Lower Beam DISPLAY switch to A.

b. Set the Upper Beam DISPLAY switch to LEFT PLUG-IN A.

c. Set the time mark generator for 0.1 microsecond markers and connect the output to the left plug-in.

d. Set the Lower Beam DISPLAY MAG switch to ×1.

e. Adjust C683 (see Fig. 6-51) to obtain a 1 marker/cm display on the lower beam. Tolerance: within ±3% or ±2.4 mm.

f. Set the time mark generator for 50 MHz (20 nSEC) sine wave output.

g. Set the Lower Beam DISPLAY MAG switch to ×10.

h. Check—1 Hz/cm display on the lower beam. Tolerance: ±5% or ±4 mm.

56. Check Timing Accuracy—B Sweep

a. Change the B Triggering MODE switch to TRIG and the SOURCE switch to INT NORM.

b. Disconnect the trigger signal from the Lower Beam TRIGGER INPUT connector.

TABLE 6-4

Timing Accuracy—B Sweep

B TIME/CM	Time Mark Generator	Check Lower Beam Display
0.1 μSEC[6]	0.1 μs	1 marker/cm
0.2 μSEC	0.1 μs	2 markers/cm
0.5 μSEC[6]	0.5 μs	1 marker/cm
1 μSEC[6]	1 μs	1 marker/cm
2 μSEC	1 μs	2 markers/cm
5 μSEC	5 μs	1 marker/cm
10 μSEC[6]	10 μs	1 marker/cm
20 μSEC	10 μs	2 markers/cm
50 μSEC	50 μs	1 marker/cm
0.1 mSEC	0.1 ms	1 marker/cm
0.2 mSEC	0.1 ms	2 markers/cm
0.5 mSEC	0.5 ms	1 marker/cm
1 mSEC[6]	1 ms	1 marker/cm
2 mSEC	1 ms	2 markers/cm
5 mSEC	5 ms	1 marker/cm
10 mSEC	10 ms	1 marker/cm
20 mSEC	10 ms	2 markers/cm
50 mSEC	50 ms	1 marker/cm
0.1 SEC	0.1 s	1 marker/cm
0.2 SEC	0.1 s	2 markers/cm
0.5 SEC	0.5 s	1 marker/cm
1 SEC	1 s	1 marker/cm
2 SEC	1 s	2 markers/cm
5 SEC	5 s	1 marker/cm

[6]Previously adjusted.

c. Check—Using Table 6-4 as a guide, check the B sweep CRT displayed accuracy with respect to the 1-cm and 9-cm graticule lines. Tolerance should be within ±3% or ±2.4 mm.

57. Check Variable Time/cm Range

a. Set the Upper Beam DISPLAY switch to RIGHT PLUG-IN A.

b. Set the B TIME/CM to 1 mSEC.

c. Set the A and B Triggering MODE switches to AUTO STABILITY.

d. Check that the A Triggering SOURCE switch is set to RIGHT INT NORM.

e. Set the time-mark generator for 10-millisecond markers.

f. Adjust the A and B Triggering LEVEL controls to obtain stable Upper and Lower Beam displays. Markers on both beams will appear at the 0-cm and 10-cm graticule lines.

g. Rotate the A and B TIME/CM VARIABLE controls fully counterclockwise; the UNCAL lights should be on.

h. Check—Horizontal distance between markers should be 4 cm or less, both displays.

i. Return both VARIABLE controls to CALIBRATED; the UNCAL lights should be off.

58. Check Trigger Delay

a. Preset the Type 556 controls as follows:

B MODE	DLY'D BY A
A and B TIME/CM	.1 μSEC
A Triggering	TRIG, +, AC, NORM INT, RIGHT
B Triggering	AUTO STABILITY, +, AC, NORM INT, RIGHT, LEVEL control fully clockwise with knob pulled outward
DELAY-TIME MULTIPLIER	10.00

b. Set the time-mark generator for 1-microsecond marker output.

c. Adjust the A triggering LEVEL control to obtain a stable display.

d. With the Upper and Lower Beam POSITION controls, position both traces to start at the 0-cm graticule line.

e. Turn the DELAY-TIME MULTIPLIER dial counterclockwise while adjusting the TRACE SEPARATION and right plug-in Vertical Position controls until the marker on the Lower Beam display is superimposed on the Upper Beam marker.

f. Check—Dial reading difference from 10.00 equal to or less than 150 nanoseconds. (One minor dial division equals one nanosecond.)

SN 2000-up only

g. Set the Upper Beam DISPLAY switch to RIGHT PLUG-IN B.

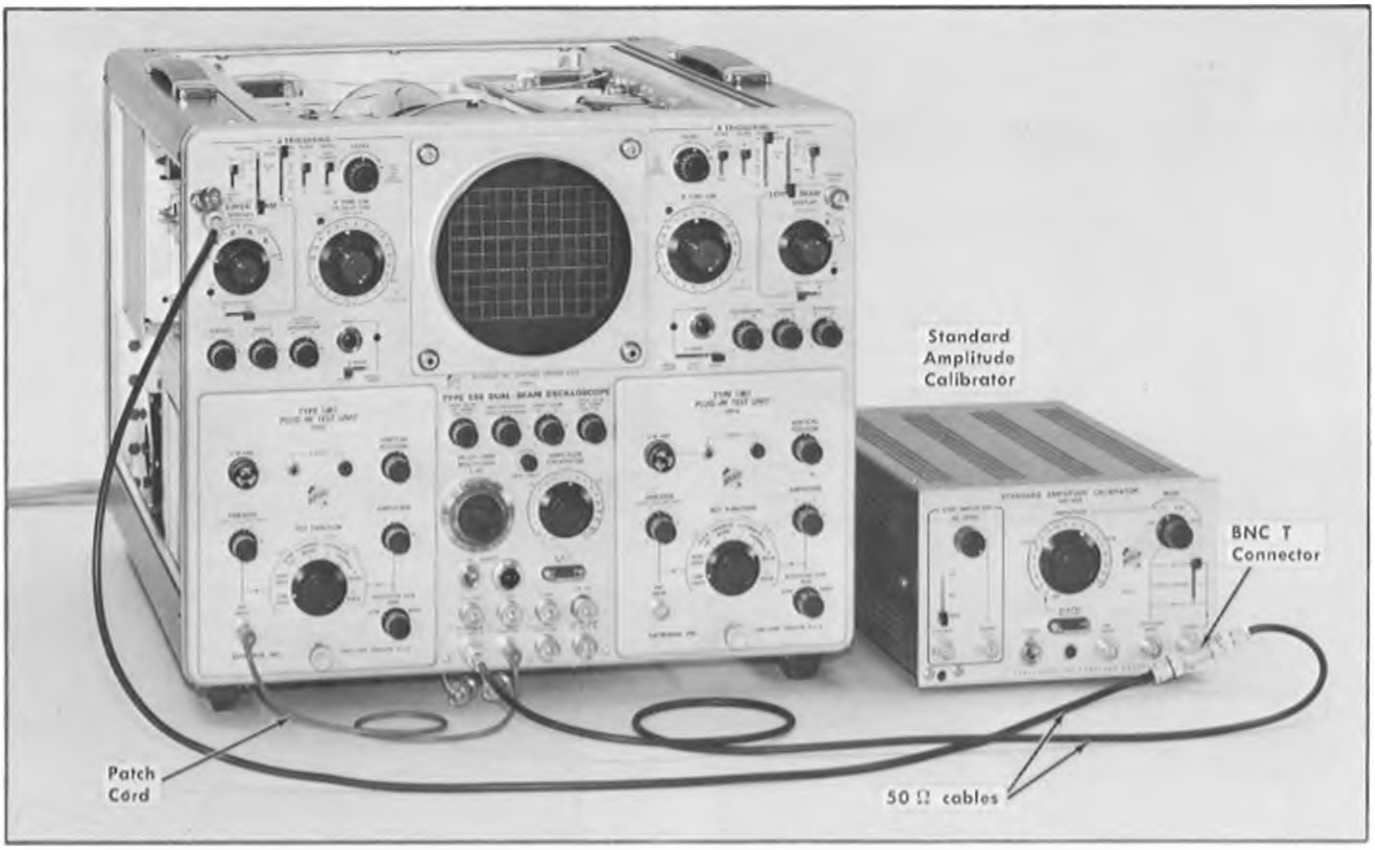


Fig. 6-52. Horizontal Amplifier Adjustment and Compensation.

h. Set the Lower Beam DISPLAY switch to RIGHT PLUG-IN A.

i. Set the B TIME/CM switch to 10 μSEC.

j. Set the time-mark generator for 1-millisecond markers and connect the output to the right plug-in.

k. Check—Turn the DELAY-TIME MULTIPLIER dial both directions; the intensified portion of the Lower Beam should move as the dial is turned.

l. Check—Rotate the Lower Beam CONTRAST control and observe its effect on the intensity of the lower beam. The intensified portion should remain at the same level while the remainder is varied by the control setting.

m. Disconnect the marker signal from the right plug-in unit.

59. Adjust External Horizontal Amplifer DC Balance—Upper Beam

a. The initial test seup is shown in Fig. 6-52.

b. Set the controls as follows:

A Triggering Controls	
SOURCE	LEFT EXT
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Near 0, knob pushed in
Upper Beam DISPLAY	LEFT PLUG-IN EXT
Upper Beam DISPLAY MAG	×10
A TIME/CM	1 mSEC
A VARIABLE	CALIBRATED
A MODE	NORM
B Triggering Controls	
SOURCE	RIGHT EXT
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Near 0, knob pushed in
Lower Beam DISPLAY	RIGHT PLUG-IN EXT
Lower Beam DISPLAY MAG	×10
B TIME/CM	1 mSEC
B VARIABLE	CALIBRATED
B MODE	NORM
Test Load Unit (both)	
Test Function	Low Load

c. Set the Standard Amplitude Calibrator to supply a 0.5-volt square-wave signal.

d. Connect the signal through a BNC T connector to the A Triggering TRIGGER INPUT connector and the UPPER BEAM EXT HORIZ IN connector.

e. Connect a patch cord from the A SAWTOOTH connector to the left test load unit Ext Input connector.

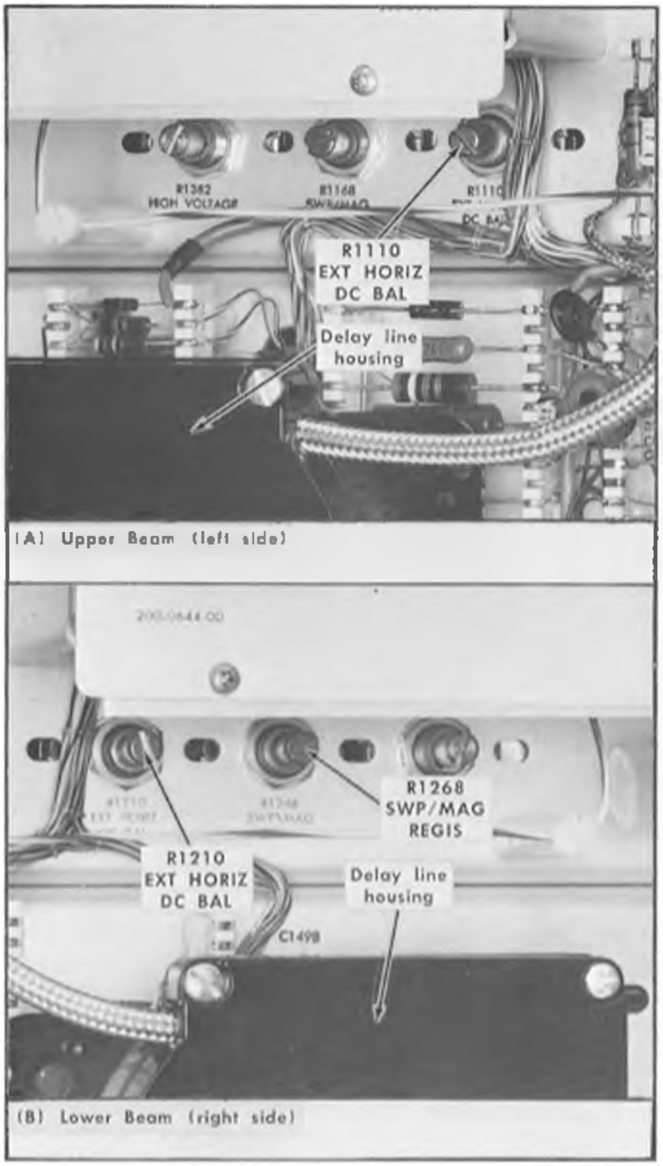


Fig. 6-53. Adjustment locations, External Horizontal Amplifier DC Balance.

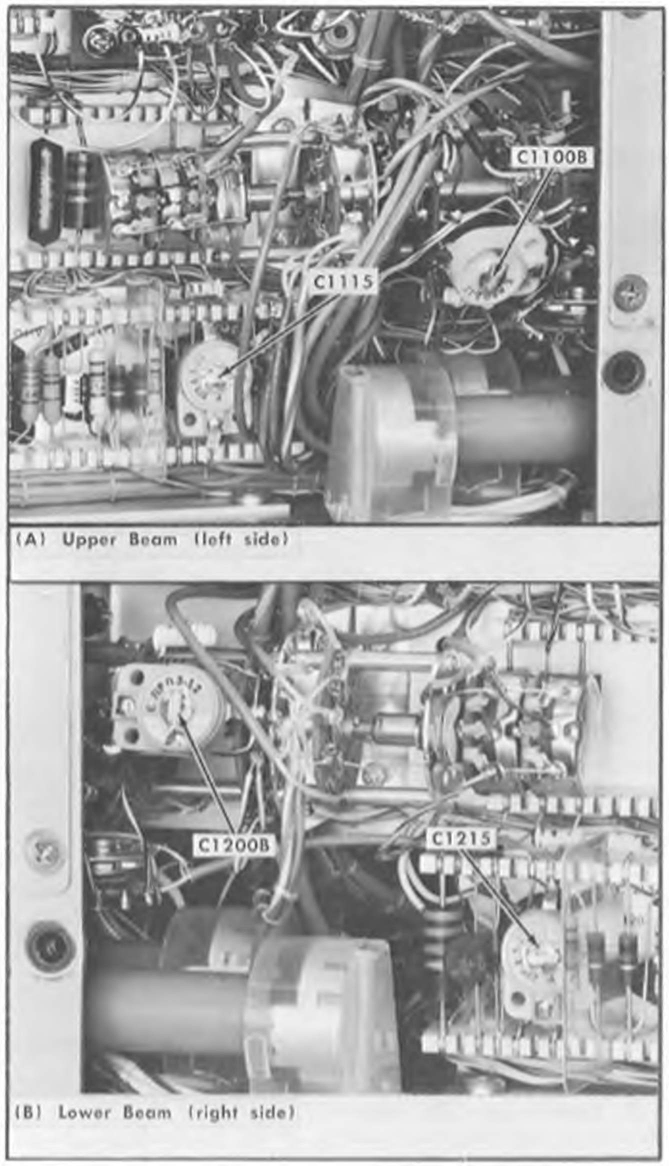


Fig. 6-54. Locations of External Horizontal Amplifier compensation adjustments.

f. Rotate the UPPER BEAM EXT HORIZ VAR 1-10 control fully clockwise.

g. Adjust the left test load unit Variable control to display 4 or 5 cycles of the waveform in the Upper Beam graticule area.

h. Position the left edge of the display to the center vertical line of the graticule.

i. Rotate the UPPER BEAM EXT HORIZ VAR 1-10 control from fully clockwise to fully counterclockwise, then fully clockwise.

j. Check—No horizontal shift of the left edge of the display as the VAR 1-10 control is rotated.

k. Adjust EXT HORIZ DC BAL R1110 (Fig. 6-53A) while rotating the VAR 1-10 control, until there is no shift of the display.

l. Return the VAR 1-10 control fully clockwise.

60. Check External Horizontal Amplifier Variable Control Range—Upper Beam

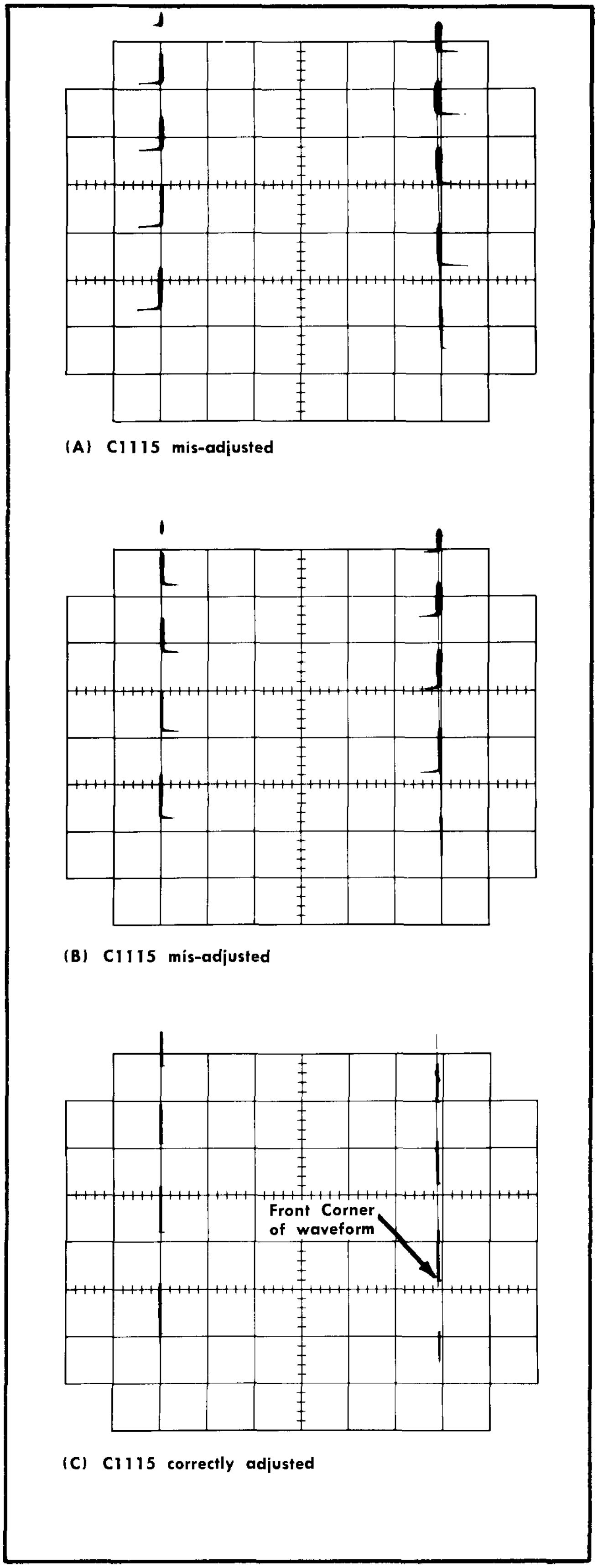
a. Position the left edge of the display to the 2-cm graticule line.

b. Check—5 cm or more of horizontal deflection.

c. Rotate the UPPER BEAM EXT HORIZ VAR 1-10 control fully counterclockwise.

d. Check—Horizontal deflection equal to or less than 10% of the deflection noted in step (b).

e. Return the VAR 1-10 control fully clockwise.



(A) C1115 mis-adjusted

(B) C1115 mis-adjusted

(C) C1115 correctly adjusted

Fig. 6-55. Horizontal Amplifier ×1 - ×10 Compensation—Upper Beam.

61. Adjust External Horizontal Amplifier ×10 Compensation—Upper Beam

a. Check—Front corner of waveform similar to Fig. 6-55C, and showing no more than 3% overshoot, rolloff, or ringing.

b. Adjust C1115 (Fig. 6-54A) for best front corner and flat top.

62. Adjust External Horizontal Amplifier ×1 Compensation—Upper Beam

a. Change the DISPLAY MAG switch to ×1.

b. Change the Standard Amplitude Calibrator output to 5 volts.

c. Check—Front corner of waveform similar to Fig. 6-55C, and showing no more than 3% overshoot, rolloff, or ringing.

d. Adjust C1100B(Fig. 6-54A) for the best front corner of the waveform.

63. Check Magnifier ×1-×10 Ratio Accuracy —Upper Beam

a. Measure the horizontal deflection of the display observed in step 62 (d).

b. Change the Standard Calibrator output to 0.5 volts.

c. Change the DISPLAY MAG switch to ×10.

d. Check—Horizontal deflection of the display should be within 3% of the display noted in step 62 (d).

e. Set the Upper Beam INTENSITY control so the display is not visible.

64. Adjust External Horizontal Amplifier DC Balance—Lower Beam

a. Move the Standard Amplitude Calibrator signal to the LOWER BEAM EXT HORIZ IN connector, and to the B Triggering EXT TRIGGER INPUT connector.

b. Move the patch cord to connect the B SAWTOOTH connector to the right test load unit Ext Input connector.

c. Rotate the LOWER BEAM EXT HORIZ IN VAR 1-10 fully clockwise.

d. Adjust the right test load unit Variable control to display. 4 or 5 cycles of the waveform in the Lower Beam graticule area.

e. Position the left edge of the display to the center vertical line of the graticule.

f. Rotate the LOWER BEAM EXT HORIZ VAR 1-10 from fully clockwise to fully counterclockwise, then fully clockwise.

g. Check—No horizontal shift of the left edge of the display as the VAR 1-10 control is rotated.

h. Adjust EXT HORIZ DC BAL R1210 (Fig. 6-53B) while rotating the VAR 1-10 control, until there is no horizontal shift of the display.

i. Return the VAR 1-10 control fully clockwise.

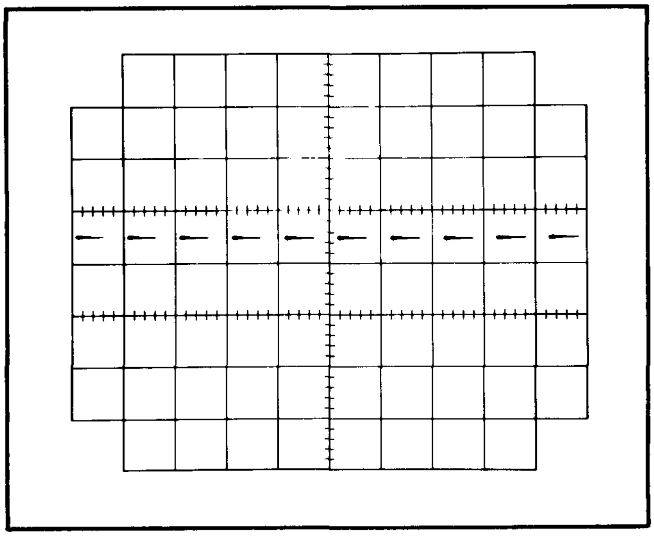


Fig. 6-56. Typical display, intensity modulation (Z Axis Operation).

65. Check External Horizontal Amplifier Variable Control Range—Lower Beam

a. Position the left edge of the display to the 2-cm graticule line.

b. Check—Horizontal deflection of the display 5 cm or more.

c. Rotate the LOWER BEAM EXT HORIZ VAR 1-10 control fully counterclockwise.

d. Check—Horizontal deflection equal to or less than 10% of the deflection noted in step (b).

e. Return the VAR 1-10 control fully clockwise.

66. Adjust External Horizontal Amplifier ×1 and ×10 Compensation—Lower Beam

a. Check—Front corner of waveform similar to Fig. 6-55C and showing no more than 3% overshoot, rolloff, or ringing.

b. Adjust C1215 (Fig. 6-54B) for best front corner and flat top.

c. Change the DISPLAY MAG to ×1.

d. Change the Standard Amplitude Calibrator output to 5 volts. Note amount of horizontal deflection because this inf ormation will be needed for step 67(a).

e. Check—Front corner of waveform similar to 6-55C, and showing no more than 3% overshoot, rolloff, or ringing.

f. Adjust C1200B (Fig. 6-54B) for the best front corner of the waveform.

67. Check Magnifier ×1-×10 Ratio Accuracy—Lower Beam

a. Measure the horizontal deflection of the display observed in step 66d.

b. Change the Standard Amplitude Calibrator output to 0.5 volts.

c. Change the DISPLAY MAG switch to ×10.

d. Check—Horizontal deflection of the display should be within 3% of the deflection noted in step 66d.

e. Reduce the Lower Beam intensity. Remove the Standard Calibrator signal and the patch cord.

f. Return the A and B Triggering SOURCE switches to NORM INT, and both DISPLAY MAG switches to ×1.

g. Set the Upper Beam DISPLAY switch to LEFT PLUG-IN A and the Lower Beam DISPLAY switch to RIGHT PLUG-IN B.

68. Check Z Axis Operation—Upper and Lower Beams

a. Set the AMPLITUDE CALIBRATOR to 10 VOLTS.

b. Check that both CRT Cathode Selector switches (on rear panel) are set to EXT CRT CATHODE.

c. Adjust the INTENSITY controls of both beams for normal viewing.

d. Remove the two BNC shorting-type caps (on rear panel) from the BNC connectors.

e. Connect a 50 Ω cable from the CAL OUT connector to the Upper Beam BNC connector on the rear panel.

f. Check that the A and B TIME/CM switches are set to 1 mSEC.

g. Check—Upper Beam CRT display for noticeable intensity modulation (see Fig. 6-56). (INTENSITY setting may have to be reduced to view trace modulation.)

h. Move the CAL OUT signal to the Lower Beam BNC connector.

i. Check—Lower Beam CRT display for intensity modulation, as in step (g).

j. Remove the AMPLITUDE CALIBRATOR signal and replace both BNC caps.

69. Check A Sweep Sawtooth Amplitude

a. The initial test setup and control settings are shown in Fig. 6-57.

b. Set controls as follows:

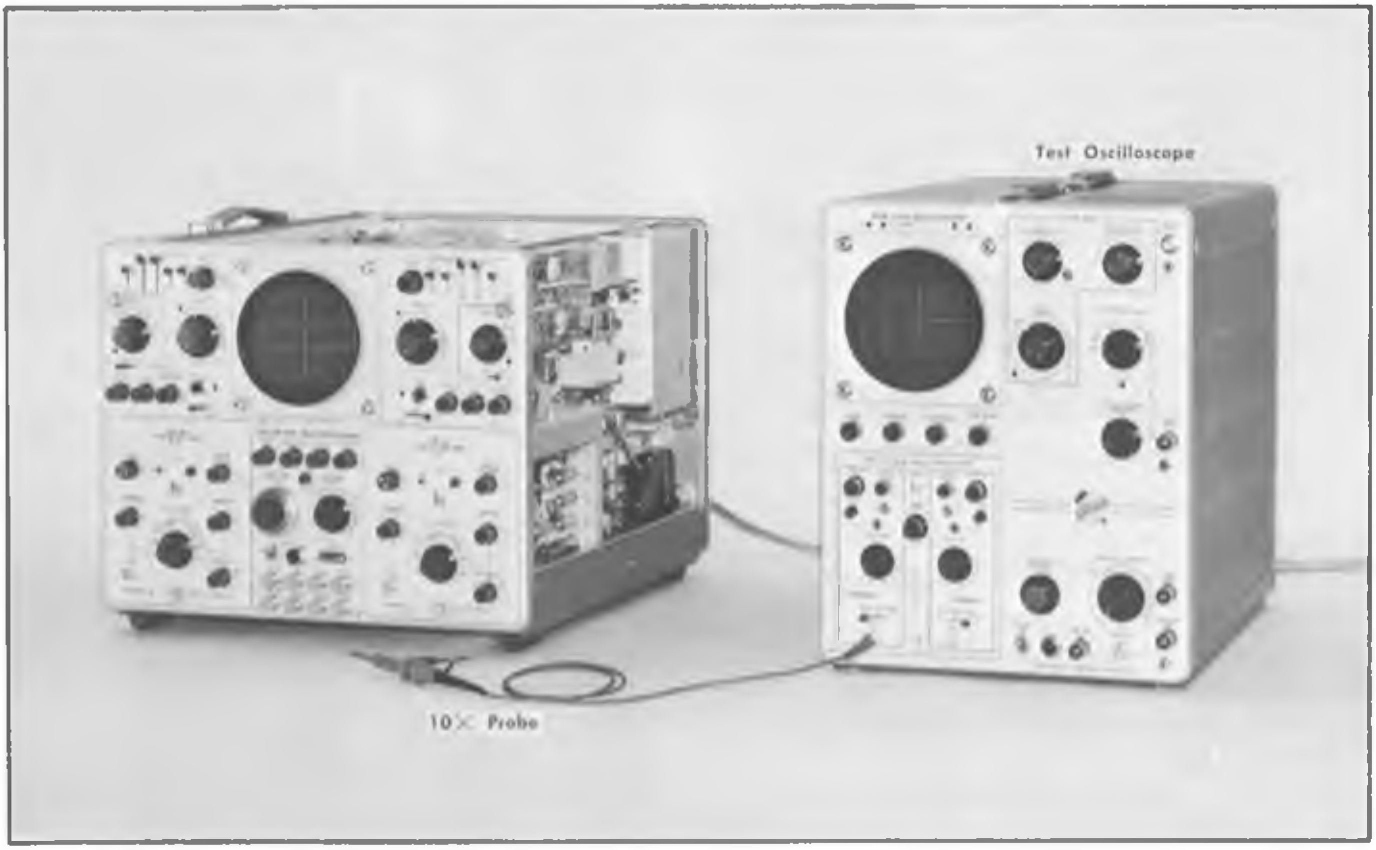


Fig. 6-57. Test equipment setup for checking external waveforms.

A Triggering Controls	
SOURCE	LEFT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Fully clockwise, knob pushed in
Upper Beam DISPLAY	LEFT PLUG-IN A
Upper Beam DISPLAY MAG	×1
A TIME/CM	1 mSEC
A VARIABLE	CALIBRATED
A MODE	NORM
B Triggering Controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Fully clockwise, knob pushed in
Lower Beam DISPLAY	RIGHT PLUG-IN B
Lower Beam DISPLAY MAG	×1
B TIME/CM	1 mSEC
B VARIABLE	CALIBRATED
B MODE	NORM
Test Load Units (both)	
Test Function	Low Load
Test Oscilloscope	
Time/cm	5 milliseconds

c. Connect a 10× probe to the test oscilloscope vertical amplifier input connector.

d. Set the test oscilloscope vertical deflection switch to 5 volts/cm.

e. Connect the probe tip to the A SAWTOOTH connector, and adjust the test oscilloscope triggering for a stable display.

f. Check—Sawtooth waveform amplitude ≥94.5 volts for a 10.5 cm A sweep.

70. Check B Sweep Sawtooth Amplitude

a. Move the probe tip to the B SAWTOOTH connector.

b. Check—Sawtooth waveform amplitude >94.5 volts for a 10.5 cm B sweep.

71. Check A Sweep Gate Amplitude

a. Connect the probe tip to the A GATE connector.

b. Change the test oscilloscope vertical deflection switch to 0.5 volts/cm.

c. Check—Gate waveform amplitude 10 volts or more.

72. Check B Sweep Gate Amplitude

a. Move the probe tip to the B GATE connector.

b. Check—Gate waveform amplitude 10 volts or more.

73. Check Delayed Trigger Waveform Amplitude

a. Change the test oscilloscope time/cm switch to 1 microsecond.

b. Check that the vertical deflection switch is set to 0.5 volts/cm.

c. Move the probe tip to the DLY'D TRIG connector.

d. Rotate the A TIME/CM switch through all positions.

e. Check—Delayed trigger pulse amplitude 7 volts or more.

NOTE

Adjustment of the test oscilloscope intensity control may be necessary to observe the pulse at the slower sweep rates.

f. Remove the probe.

74. Adjust 8606 Bias

NOTE

The 8608 BIAS adjustments performed in this step affect the adjustments in step 75 through 77 but the opposite is not true. Once step 74 has been completed, any aberrations that appear in the waveforms as a result of performing the step can be removed by performing steps 75 through 77 without affecting the 8608 BIAS adjustments.

a. Set the controls as follows:

A Triggering controls	
SOURCE	LEFT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Near 0, knob pushed in
Upper Beam DISPLAY	LEFT PLUG-IN A
Upper Beam DISPLAY MAG	×1
A TIME/CM	.1 mSEC

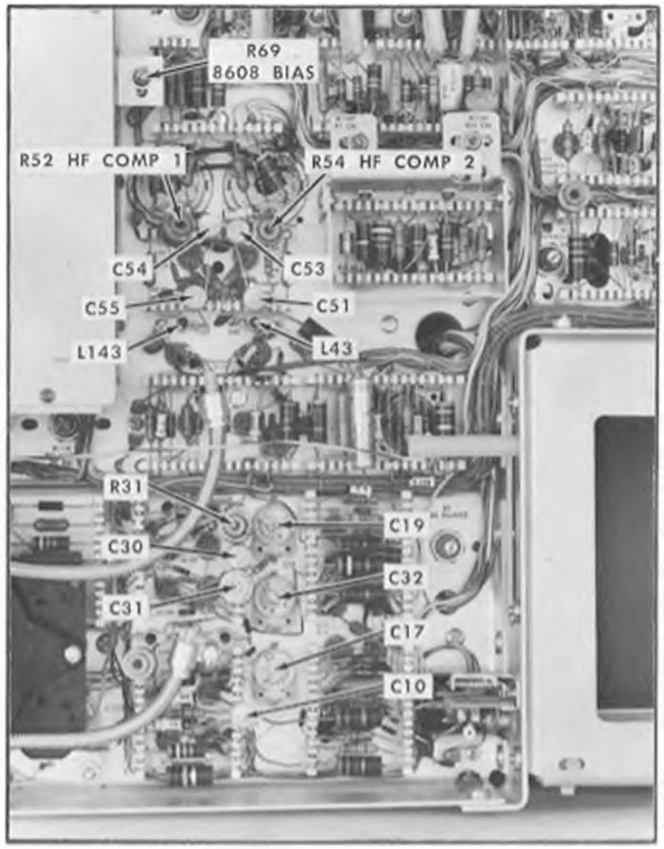


Fig. 6-58. Vertical Amplifier high-frequency compensation adjustment locations, left side; left bottom rail removed.

A VARIABLE	CALIBRATED
A MODE	NORM
B Triggering controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Near 0, knob pushed in
Lower Beam DISPLAY	RIGHT PLUG-IN B
Lower Beam DISPLAY MAG	×1
B TIME/CM	.1 mSEC
B VARIABLE	CALIBRATED
B MODE	NORM
Test Load Units (both)	
Test Function	+ Pulse
Pulse Repetition Rate	Low

b. Adjust the right plug-in Vertical Position control to move the Lower Beam below the viewing area.

c. With the left plug-in Vertical Position control, center the display within the Upper Beam viewing area.

d. Adjust the amplitude of the display to 5 cm with the left plug-in Amplitude control. Use the left plug-in Vertical Position control to keep the display centered within the Upper Beam viewing area.

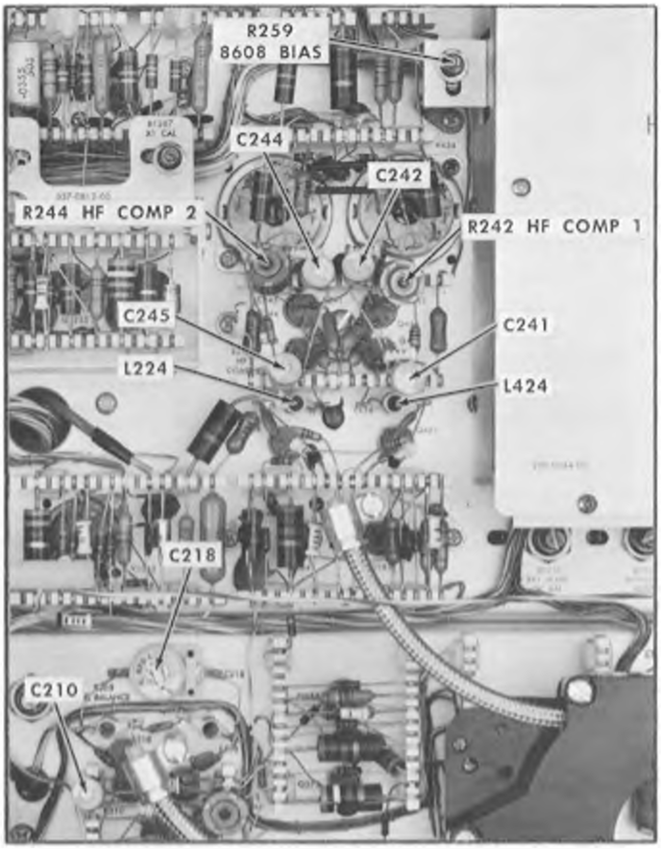


Fig. 6-59. Vertical Amplifier high-frequency compensation adjustment locations, right side.

e. Check—Upper Beam CRT display for flat top.

f. Adjust R69 (see Fig. 6-58) so the front portion of the displayed waveform flat top is rolled off slightly. Readjust R69 so the front portion of the flat top just becomes flat.

g. Change the left plug-in Pulse Repetition Rate control to Med.

h. Change the A TIME/CM switch to .1 μSEC.

i. Set the Upper Beam POSITION control so the rising portion of the pulse is located near the center of the graticule.

j. With the left plug-in Vertical Position control, move the waveform so the front-corner is located 3 cm above the Upper Beam graticule center horizontal line. Note the appearance of the front corner of the waveform.

k. Using the left plug-in Vertical Position control, move the flat top portion of the display 3 cm below the Upper Beam graticule center horizontal line.

l. Check—For no change in front corner of the waveform. Allowable front corner change is $\leq$2.25% of 50 mm or $\leq$1.125 mm.

m. Change the left plug-in Test Function switch to —Pulse, and the Type 556 A Triggering SLOPE switch to —. The waveform will now appear as a negative-going pulse.

n. Repeat step (j) through (l) but position the lower leading corner of the waveform to the same points described in the steps.

o. Check—Change in front corner of the waveform should be $\leq$2.25% of 50 mm or $\leq$1.125 mm.

p. Readjust R69 slightly so the front-corner change is within the limits stated in step (o).

q. Change the left plug-in Test Function switch to +Pulse, and the Type 556 A Triggering SLOPE switch to +.

r. Adjust the left plug-in Vertical Position control to move the Upper Beam display below the viewing area.

s. Repeat steps (c) and (d) for the right plug-in unit and Lower Beam.

t. Check—Lower Beam CRT display for flat top.

u. Adjust R259 (see Fig. 6-59) so the front portion of the display waveform flat top is rolled off slightly. Readjust R259 so the front-portion of the flat top just becomes flat.

v. Repeat steps (g) through (k) for the right plug-in unit and Lower Beam.

w. Check—For no change in front corner of the waveform. Allowable front corner change is $\leq$2.25% of 50 mm or $\leq$1.125 mm.

x. Repeat steps (m) and (n) for the right plug-in unit and Lower Beam.

y. Check—Change in front corner of the waveform should be $\leq$2.25% of 50 mm or $\leq$1.125 mm.

z. Readjust R259 slightly so the front-corner change is within the limits stated in step (y).

aa. Change the right plug-in Test Function switch to +Pulse, and the Type 556 B Triggering SLOPE switch to +.

75. Adjust Vertical Amplifier High Frequency Compensations—Left

a. Set the controls as follows:

A Triggering controls	
SOURCE	LEFT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Near 0, knob pushed in
Upper Beam DISPLAY	LEFT PLUG-IN A
Upper Beam DISPLAY MAG	×1
A TIME/CM	.1 μSEC
A VARIABLE	CALIBRATED
A MODE	NORM

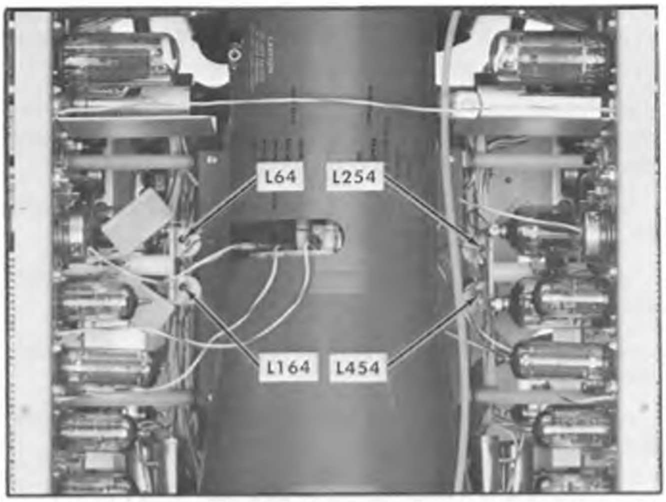


Fig. 6-60. Left and Right Vertical Amplifier high-frequency compensation adjustment locations (top view of the instrument).

B Triggering controls	
SOURCE	RIGHT INT NORM
COUPLING	AC
SLOPE	+
MODE	AUTO STABILITY
LEVEL	Near 0, knob pushed in
Lower Beam DISPLAY	RIGHT PLUG-IN B
Lower Beam DISPLAY MAG	×1
B TIME/CM	.1 μSEC
B VARIABLE	CALIBRATED
B MODE	NORM
Test Load Units (both)	
Test Function	+ Pulse
Pulse Repetition Rate	Med

b. Set the right plug-in Vertical Position control so the Lower Beam display is positioned below the graticule viewing area.

c. Set the left plug-in Vertical Position control so the Upper Beam display is positioned into view. Position the top corner of the pulse near the vertical centerline and about 1.5 cm above the Upper Beam horizontal center line.

d. Check—Upper Beam CRT display for optimum square corner and flat top, with peak overshoot, rolloff, or ringing not to exceed $\leq$2.25% of 50 mm or $\leq$1.125 mm. See Fig. 6-61A for a typical display.

e. Adjust left amplifier compensations as shown in Table 6-5. Adjustment locations are shown in Fig. 6-58 and Fig. 6-60.

TABLE 6-5

Adjustment	Area of Waveform Affected (approximate distance from leading edge near top corner[7] of waveform)
Left Amplifier	
L43	Leading edge (adjust with L143).
L143	Leading edge (adjust with L43).
L64	10 nanoseconds (adjust with L164).
L164	10 nanoseconds (adjust with L64).
R52 HF Comp 1	Adjusts damping of slowest ringing component.
R54 HF Comp 2	Adjusts damping of fastest ringing component.
C10	Leading edge to 5 nanoseconds.
C17	330 nanoseconds (termination bump).
C51	Level of major front portion. Adjust at sweep rate of 10 microseconds/cm.
C53	Leading edge to 20 nanoseconds.
C54	Leading edge to 5 nanoseconds.
C55	10 to 30 nanoseconds.
Crossover Amplifier	
R31	Adjust with C30 for minimum ringing.
C19	330 nanoseconds (termination bump).
C30	Adjust with R31 for minimum ringing.
C31	Leading edge to 75 nanoseconds.
C32	Level of major front portion. Adjust at sweep rate of 10 microseconds/cm.
Right Amplifier	
L254	10 nanoseconds (adjust with L454.).
L454	10 nanoseconds (adjust with L254).
L224	Leading edge (adjust with L424).
L424	Leading edge (adjust with L224).
R242 HF Comp 1	Adjusts damping of slowest ringing component.
R244 HF Comp 2	Adjusts damping of fastest ringing component.
C210	Leading edge to 5 nanoseconds.
C218	330 nanoseconds (termination bump).
C241	Level of major front portion. Adjust at sweep rate of 10 microseconds/cm.
C242	Leading edge to 20 nanoseconds.
C244	Leading edge to 5 nanoseconds.
C245	10 to 30 nanoseconds.

[7] For positive-going pulse waveform; near bottom corner when viewing a negative-going pulse waveform.

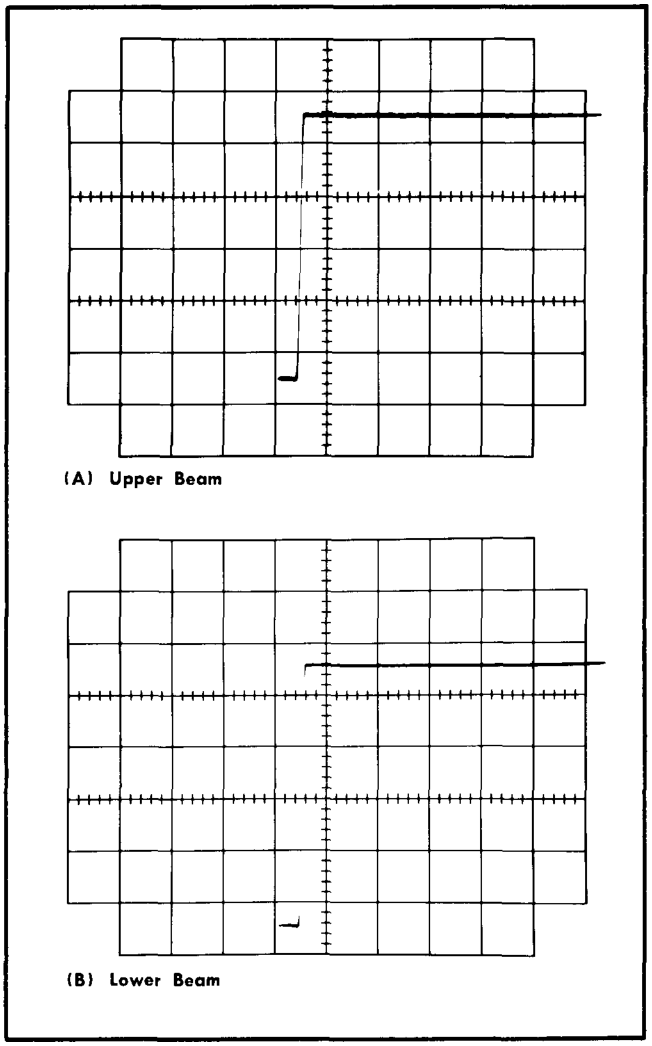


Fig. 6-61. Typical displays, high-frequency compensations correctly adjusted.

If the pulse waveform does not meet the requirements outlined in step (d) and re-adjustments are indicated, minimum adjustments of C51, C53, C54, C55, C10, R52 and R54 may be sufficient. However, if the CRT display indicates that the circuit is seriously misadjusted, adjust R52 and R54 for minimum ringing, and then proceed with small adjustments to the capacitors.

Each resistor and capacitor time-constant network affects a different portion of the waveform; however, each adjustment interacts with all other adjustments. Close observation of the waveform while switching the DISPLAY MAG from ×1 to ×10 and vice versa as the adjustments are made will result in a square corner and flat top as illustrated in Fig. 6-61 (A) and (B). Also see Fig. 6-62 for an example of misadjustment.

76. Adjust Vertical Amplifier High Frequency Compensations—Crossover

a. Change the A Triggering SOURCE switch to RIGHT INT NORM, and the Upper Beam DISPLAY switch to RIGHT PLUG-IN A.

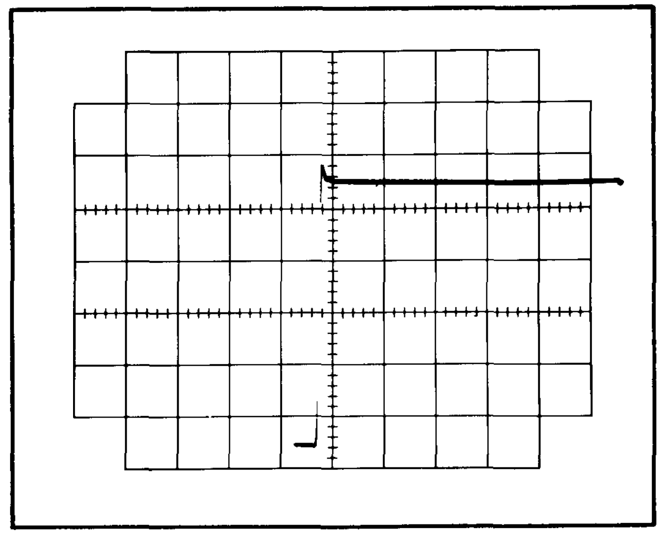


Fig. 6-62. Example of misadjustment of C244, right vertical amplifier; sweep speed 100 nanoseconds/cm.

b. Adjust the amplitude of the Upper Beam display to 5 cm with the right test load unit Amplitude control. Use the TRACE SEPARATION and right plug-in Vertical Position controls to position the rising portion of the displays near their respective graticule centers.

c. Set the Lower Beam INTENSITY control so the Lower Beam is not visible.

d. Check—Upper Beam CRT display for optimum square corner and flat top, with peak overshoot, rolloff, or ringing not to exceed $\leq$2.25% of 50 mm or $\leq$1.125 mm. See Fig. 6-61A for a typical display.

e. Adjust crossover amplifier compensations as indicated in Table 6-5.

77. Adjust Vertical Amplifier High Frequency Compensations—Right

a. Set the Lower Beam INTENSITY control so the Lower Beam display is visible and decrease the Upper Beam INTENSITY control to remove the Upper Beam display.

b. Check that the Lower Beam display is located in the center of the Lower Beam graticule area, with the rising portion of the waveform near the center vertical line.

c. Check—Lower Beam CRT display for optimum square corner and flat top, with peak overshoot, rolloff, or ringing not to exceed $\leq$2.25% of 50 mm or $\leq$1.125 mm. See Fig. 6-61B for a typical display.

d. Adjust right amplifier compensations as indicated in Table 6-5.

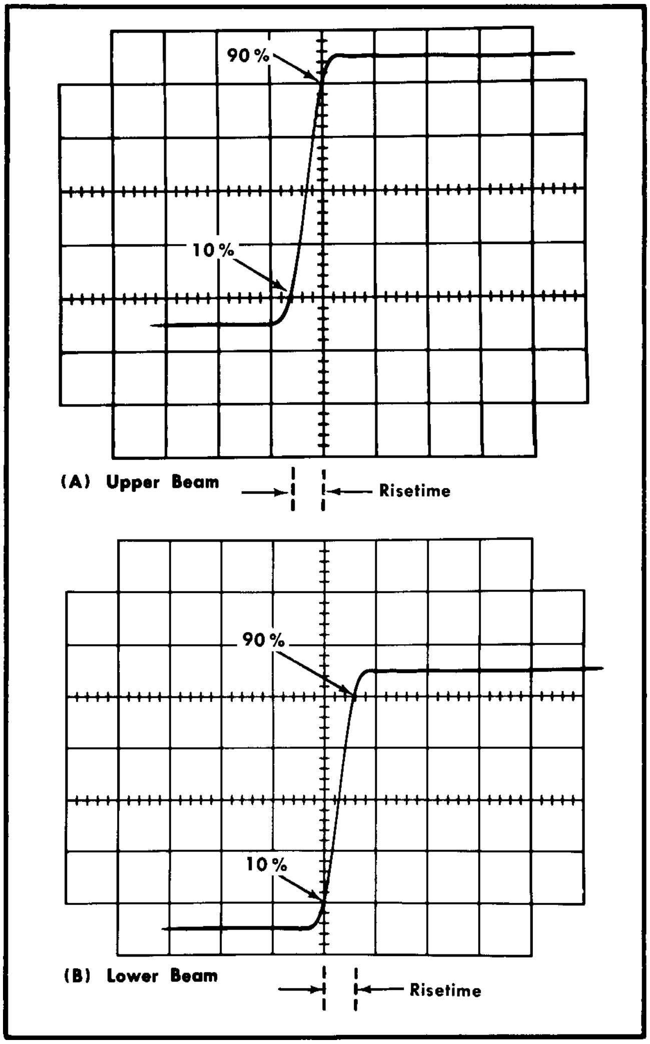


Fig. 6-63. Illustrating method of risetime measurement.

78. Check Vertical Amplifier Risetime—Right

a. Check that the B TIME/CM switch is set to .1 μSEC.

b. Set the Lower Beam DISPLAY MAG to ×10.

c. Position the 5-cm Lower Beam display so that the 10% point on the rising portion crosses the intersection of the 1-cm horizontal graticule line and the vertical graticule center line. See Fig. 6-63B for correct display positioning.

d. Check—Risetime of the 10% to 90% portion of the rising portion should be 6.93 nanoseconds or less with the test load unit pulse risetime of 3 nanoseconds. Fig. 6-63B shows a typical display.

NOTE

When performing steps 78 through 80, take into consideration sweep timing error, if any, and/or geometry and orthogonality in the area where the measurement is made.

79. Check Vertical Amplifier Risetime—Crossover

a. Decrease the Lower Beam INTENSITY so that the Lower Beam display disappears, and increase the Upper Beam INTENSITY control so the Upper Beam display becomes visible. Set the Upper Beam DISPLAY MAG switch to ×10.

b. With the TRACE SEPARATION and Upper Beam POSITION controls, position the Upper Beam 5-cm display so that the 10% point on the rising portion of the waveform crosses the intersection of the Lower Beam graticule horizontal center line with graticule vertical center line. Fig. 6-63A shows the correct positioning of the display.

c. Check—Risetime of the 10% to 90% portion of the pulse rise should be 6.93 nanoseconds or less.

80. Check Vertical Amplifier Risetime—Left

a. Change the A Triggering SOURCE switch to LEFT INT NORM.

b. Change the Upper Beam DISPLAY to LEFT PLUG-IN A.

c. With the left test load unit Vertical Position and Upper Beam POSITION controls, position the 5-cm display so that the 10% point on the rising portion of the waveform is at the same point as in step 79 (b).

d. Check—Risetime of the 10% to 90% portion of the pulse rise should be 6.93 nanoseconds or less.

NOTES

NOTES

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial or model number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

SPECIAL NOTES AND SYMBOLS

×000	Part first added at this serial number
00×	Part removed after this serial number
*000-0000-00	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, Inc., or reworked or checked components.
Use 000-0000-00	Part number indicated is direct replacement.
◐	Screwdriver adjustment.
▭	Control, adjustment or connector.

ABBREVIATIONS AND SYMBOLS

A or amp	amperes
AC or ac	alternating current
AF	audio frequency
α	alpha—common-base current amplification factor
AM	amplitude modulation
$\approx$	approximately equal to
β	beta—common-emitter current amplification factor
BHB	binding head brass
BHS	binding head steel
BNC	baby series "N" connector
$\times$	by or times
C	carbon
C	capacitance
cap.	capacitor
cer	ceramic
cm	centimeter
comp	composition
conn	connector
$\sim$	cycle
c/s or cps	cycles per second
CRT	cathode-ray tube
csk	countersunk
Δ	increment
dB	decibel
dBm	decibel referred to one milliwatt
DC or dc	direct current
DE	double end
$^\circ$	degrees
$^\circ$C	degrees Celsius (degrees centigrade)
$^\circ$F	degrees Fahrenheit
$^\circ$K	degrees Kelvin
dia	diameter
$\div$	divide by
div	division
EHF	extremely high frequency
elect.	electrolytic
EMC	electrolytic, metal cased
EMI	electromagnetic interference (see RFI)
EMT	electrolytic, metal tubular
ε	epsilon—2.71828 or % of error
$\geq$	equal to or greater than
$\leq$	equal to or less than
ext	external
F or f	farad
F & I	focus and intensity
FHB	flat head brass
FHS	flat head steel
Fil HB	fillister head brass
Fil HS	fillister head steel
FM	frequency modulation
ft	feet or foot
G	giga or 10^9
g	acceleration due to gravity
Ge	germanium
GHz	gigahertz
GMV	guaranteed minimum value
GR	General Radio
$>$	greater than
H or h	henry
h	height or high
hex.	hexagonal
HF	high frequency
HHB	hex head brass
HHS	hex head steel
HSB	hex socket brass
HSS	hex socket steel
HV	high voltage
Hz	hertz (cycles per second)
ID	inside diameter
IF	intermediate frequency
in.	inch or inches
incd	incandescent
∞	infinity
int	internal
$\int$	integral
k	kilohms or kilo (10^3)
k Ω	kilohm
kc	kilocycle
kHz	kilohertz
L	inductance
λ	lambda—wavelength
$\gg$	large compared with
$<$	less than
LF	low frequency
lg	length or long
LV	low voltage
M	mega or 10^6
m	milli or 10^{-3}
MΩ or meg	megohm
μ	micro or 10^{-6}
mc	megacycle
met.	metal
MHz	megahertz
mm	millimeter
ms	millisecond
$-$	minus
mtg hdw	mounting hardware
n	nano or 10^{-9}
no. or #	number
ns	nanosecond
OD	outside diameter
OHB	oval head brass
OHS	oval head steel
Ω	omega—ohms
ω	omega—angular frequency
p	pico or 10^{-12}
/	per
%	percent
PHB	pan head brass
ϕ	phi—phase angle
π	pi—3.1416
PHS	pan head steel
$+$	plus
$\pm$	plus or minus
PIV	peak inverse voltage
plstc	plastic
PMC	paper, metal cased
poly	polystyrene
prec	precision
PT	paper, tubular
PTM	paper or plastic, tubular, molded
pwr	power
Q	figure of merit
RC	resistance capacitance
RF	radio frequency
RFI	radio frequency interference (see EMI)
RHB	round head brass
ρ	rho—resistivity
RHS	round head steel
r/min or rpm	revolutions per minute
RMS	root mean square
s or sec.	second
SE	single end
Si	silicon
SN or S/N	serial number
$\ll$	small compared with
T	tera or 10^{12}
TC	temperature compensated
TD	tunnel diode
THB	truss head brass
θ	theta—angular phase displacement
thk	thick
THS	truss head steel
tub.	tubular
UHF	ultra high frequency
V	volt
VAC	volts, alternating current
var	variable
VDC	volts, direct current
VHF	very high frequency
VSWR	voltage standing wave ratio
W	watt
w	wide or width
w/	with
w/o	without
WW	wire-wound
xmfr	transformer

SECTION 7
ELECTRICAL PARTS LIST

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			

Bulbs

Ckt. No.	Tektronix Part No.	Eff	Disc	Description			
B619	150-0048-00			Incandescent #683		5 V 60 mA	
B663	150-0035-00			Neon, A1D T2			
B670	150-0051-00			Neon, NE-83			
B819	150-0048-00			Incandescent #683		5 V 60 mA	
B863	150-0035-00			Neon, A1D T2			
B870	150-0051-00			Neon, NE-83			
B1120	150-0048-00			Incandescent #683		5 V 60 mA	
B1173	150-0051-00			Neon, NE-83			
B1178	150-0051-00			Neon, NE-83			
B1183	150-0051-00			Neon, NE-83			
B1220	150-0048-00			Incandescent #683		5 V 60 mA	
B1273	150-0051-00			Neon, NE-83			
B1278	150-0051-00			Neon, NE-83			
B1283	150-0051-00			Neon, NE-83			
B1534	150-0031-00			Incandescent #44	Graticule Light		
B1535	150-0031-00			Incandescent #44	Graticule Light		
B1536	150-0001-00			Incandescent #47	Pilot Light		

Capacitors

Tolerance ±20% unless otherwise indicated.

Ckt. No.	Tektronix Part No.	Eff	Disc	Description			
C2	283-0001-00			0.005 μF	Cer	500 V	
C10	281-0060-00	100	829	2-8 pF, Var	Cer		
C10	281-0036-00	830		3-12 pF, Var	Cer		
C13	281-0513-00			27 p F	Cer	500 V	
C16	283-0028-00			0.0022 μF	Cer	50 V	
C17	281-0005-00			1.5-7 pF, Var	Cer		
C19	281-0012-00			7-45 pF, Var	Cer		
C20	283-0001-00			0.005 μF	Cer	500 V	
C26	283-0001-00			0.005 μF	Cer	500 V	
C30	281-0060-00			2-8 pF, Var	Cer		
C31	281-0029-00			1.5-7 pF, Var	Cer		
C32	281-0005-00			1.5-7 pF, Var	Cer		
C39	283-0028-00			0.0022 μF	Cer	50 V	
C41	281-0572-00			6.8 pF	Cer	500 V	±0.5 pF
C42	283-0028-00			0.0022 μF	Cer	50 V	

Capacitors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
C47	281-0510-00			22 pF	Cer	500 V	
C49	281-0630-00			390 pF	Cer	500 V	5%
C50	281-0528-00	100	829	82 pF	Cer	500 V	10%
C50	281-0523-00	830		100 pF	Cer	350 V	
C51	281-0063-00			9-35 pF, Var	Cer		
C52	281-0513-00			27 pF	Cer	500 V	
C53	281-0063-00			9-35 pF, Var	Cer		
C54	281-0063-00			9-35 pF, Var	Cer		
C55	281-0060-00			2-8 pF, Var	Cer		
C56	281-0504-00	X830		10 pF	Cer	500 V	10%
C58	283-0001-00			0.005 μF	Cer	500 V	
C60	283-0000-00	X830		0.001 μF	Cer	500 V	
C65	283-0000-00			0.001 μF	Cer	500 V	
C70	283-0000-00			0.001 μF	Cer	500 V	
C71	283-0000-00			0.001 μF	Cer	500 V	
C81	281-0592-00			4.7 pF	Cer		±0.5 pF
C82	283-0000-00			0.001 μF	Cer	500 V	
C87	283-0000-00			0.001 μF	Cer	500 V	
C90	281-0523-00			100 pF	Cer	350 V	
C91	281-0592-00			4.7 pF	Cer		±0.5 pF
C93	283-0079-00			0.01 μF	Cer	250 V	
C94	283-0002-00			0.01 μF	Cer	500 V	
C99	283-0000-00			0.001 μF	Cer	500 V	
C100	281-0601-00			7.5 pF	Cer	500 V	±0.5 pF
C106	283-0000-00			0.001 μF	Cer	500 V	
C110	281-0550-00	X830		120 pF	Cer	500 V	10%
C113	281-0513-00			27 pF	Cer	500 V	
C115	281-0513-00			27 pF	Cer	500 V	
C116	283-0028-00			0.0022 μF	Cer	50 V	
C139	283-0028-00			0.0022 μF	Cer	50 V	
C141	281-0572-00			6.8 pF	Cer	500 V	±0.5 pF
C142	283-0028-00			0.0022 μF	Cer	50 V	
C148	283-0000-00			0.001 μF	Cer	500 V	
C158	283-0001-00			0.005 μF	Cer	500 V	
C160	283-0000-00	X830		0.001 μF	Cer	500 V	
C170	283-0000-00			0.001 μF	Cer	500 V	
C187	283-0002-00			0.01 μF	Cer	500 V	
C202	283-0001-00			0.005 μF	Cer	500 V	
C207	281-0550-00	X830		120 pF	Cer	500 V	10%
C210	281-0060-00	100	829	2-8 pF, Var	Cer		
C210	281-0036-00	830		3-12 pF, Var	Cer		
C213	281-0513-00			27 pF	Cer	500 V	
C216	283-0028-00			0.0022 μF	Cer	50 V	
C218	281-0005-00			1.5-7 pF, Var	Cer		
C222	281-0572-00			6.8 pF	Cer	500 V	±0.5 pF

Capacitors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
C225	283-0028-00			0.0022 μF	Cer	50 V	
C230	281-0510-00			22 pF	Cer	500 V	
C231	283-0000-00			0.001 μF	Cer	500 V	
C239	281-0630-00			390 pF	Cer	500 V	5%
C240	281-0528-00	100	829	82 pF	Cer	500 V	10%
C240	281-0523-00	830		100 pF	Cer	350 V	10%
C241	281-0063-00			9-35 pF, Var	Cer		
C242	281-0063-00			9-35 pF, Var	Cer		
C243	281-0513-00			27 pF	Cer	500 V	
C244	281-0063-00			9-35 pF, Var	Cer		
C245	281-0060-00			2-8 pF, Var	Cer		
C246	281-0504-00	X830		10 pF	Cer	500 V	10%
C248	283-0001-00			0.005 μF	Cer	500 V	
C250	283-0000-00	X830		0.001 μF	Cer	500 V	
C255	283-0000-00			0.001 μF	Cer	500 V	
C260	283-0000-00			0.001 μF	Cer	500 V	
C261	283-0000-00			0.001 μF	Cer	500 V	
C271	281-0592-00			4.7 pF	Cer		±0.5 pF
C272	283-0000-00			0.001 μF	Cer	500 V	
C277	283-0000-00			0.001 μF	Cer	500 V	
C280	281-0523-00			100 pF	Cer	350 V	
C281	281-0592-00			4.7 pF	Cer		±0.5 pF
C283	283-0079-00			0.01 μF	Cer	250 V	
C284	283-0002-00			0.01 μF	Cer	500 V	
C289	283-0000-00			0.001 μF	Cer	500 V	
C297	283-0002-00			0.01 μF	Cer	500 V	
C400	281-0601-00			7.5 pF	Cer	500 V	±0.5 pF
C413	281-0513-00			27 pF	Cer	500 V	
C414	281-0513-00			27 pF	Cer	500 V	
C416	283-0028-00			0.0022 μF	Cer	50 V	
C422	281-0572-00			6.8 pF	Cer	500 V	±0.5 pF
C425	283-0028-00			0.0022 μF	Cer	50 V	
C448	283-0001-00			0.005 μF	Cer	500 V	
C450	283-0000-00	X830		0.001 μF	Cer	500 V	
C460	283-0000-00			0.001 μF	Cer	500 V	
C500	283-0002-00			0.01 μF	Cer	500 V	
C501	283-0092-00			0.03 μF	Cer	200 V	+80%—20%
C502	283-0032-00			470 pF	Cer	500 V	5%
C504	281-0603-00			39 pF	Cer	500 V	5%
C508	283-0002-00			0.01 μF	Cer	500 V	
C512	283-0001-00			0.005 μF	Cer	500 V	
C520	283-0095-00			56 pF	Cer	200 V	10%
C525	283-0001-00			0.005 μF	Cer	500 V	
C526	281-0523-00			100 pF	Cer	350 V	
C528	283-0001-00			0.005 μF	Cer	500 V	

Capacitors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
C547	283-0028-00			0.0022 μF	Cer	50 V	
C552	281-0580-00			470 pF	Cer	500 V	10%
C558	283-0000-00			0.001 μF	Cer	500 V	
C560	281-0503-00			8 pF	Cer	500 V	±0.5 pF
C561	281-0508-00			12 pF	Cer	500 V	
C567	283-0026-00			0.2 μF	Cer	25 V	
C574	281-0518-00			47 pF	Cer	500 V	
C577	283-0077-00			330 pF	Cer	500 V	5%
C578	281-0504-00	X2000		10 pF	Cer	500 V	10%
C581	281-0543-00			270 pF	Cer	500 V	10%
C583	283-0002-00			0.01 μF	Cer	500 V	
C584	281-0504-00	100	1999X	10 pF	Cer	500 V	10%
C586	281-0523-00	100	1999	100 pF	Cer	350 V	
C586	281-0540-00	2000		51 pF	Cer	500 V	5%
C589	283-0002-00			0.01 μF	Cer	500 V	
C604	283-0026-00			0.2 μF	Cer	25 V	
C611	290-0187-00			4.7 μF	Elect.	35 V	
C614	283-0002-00			0.01 μF	Cer	500 V	
C622	281-0543-00			270 pF	Cer	500 V	10%
C631	281-0513-00			27 pF	Cer	500 V	
C635	281-0518-00			47 pF	Cer	500 V	
C637	281-0523-00			100 pF	Cer	350 V	
C643	283-0000-00			0.001 μF	Cer	500 V	
C648	281-0523-00			100 pF	Cer	350 V	
C660A				10 μF			
C660B				1 μF			
C660C	*295-0099-00			0.1 μF	Timing Capacitor		
C660D				0.01 μF			
C660E				997.5 pF			
C660F	281-0574-00			82 pF	Cer	500 V	10%
C660G	281-0010-00			4.5-25 pF, Var	Cer		
C660H	281-0007-00			3-12 pF, Var	Cer		
C660J	281-0007-00			3-12 pF, Var	Cer		
C666	283-0001-00			0.005 μF	Cer	500 V	
C668	281-0528-00			82 pF	Cer	500 V	10%
C673	283-0002-00			0.01 μF	Cer	500 V	
C674	283-0010-00			0.05 μF	Cer	50 V	
C675A	285-0576-00			1 μF	PTM	100 V	10%
C675B	285-0633-00			0.22 μF	PTM	100 V	10%
C675C	285-0636-00			0.022 μF	PTM	200 V	
C675D	285-0543-00			0.0022 μF	MT	400 V	
C675E	281-0550-00			120 pF	Cer	500 V	10%
C676	281-0550-00			120 pF	Cer	500 V	10%
C681	281-0010-00			4.5-25 pF, Var	Cer		

Capacitors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
C683	281-0010-00	X2000		4.5-25 pF, Var	Cer		
C688	283-0000-00			0.001 μF	Cer	500 V	
C696	283-0002-00			0.01 μF	Cer	500 V	
C698	283-0002-00			0.01 μF	Cer	500 V	
C699	283-0002-00			0.01 μF	Cer	500 V	
C700	283-0002-00			0.01 μF	Cer	500 V	
C701	283-0092-00			0.03 μF	Cer	200 V	+80%−20%
C702	283-0032-00			470 pF	Cer	500 V	5%
C704	281-0603-00			39 pF	Cer	500 V	5%
C708	283-0002-00			0.01 μF	Cer	500 V	
C712	283-0001-00			0.005 μF	Cer	500 V	
C720	283-0095-00			56 pF	Cer	200 V	10%
C725	283-0001-00			0.005 μF	Cer	500 V	
C726	281-0523-00			100 pF	Cer	350 V	
C728	283-0001-00			0.005 μF	Cer	500 V	
C747	283-0028-00			0.0022 μF	Cer	50 V	
C752	281-0580-00			470 pF	Cer	500 V	10%
C758	283-0000-00			0.001 μF	Cer	500 V	
C760	281-0503-00			8 pF	Cer	500 V	±0.5 pF
C761	281-0508-00			12 pF	Cer	500 V	
C767	283-0026-00			0.2 μF	Cer	25 V	
C774	281-0518-00			47 pF	Cer	500 V	
C777	283-0077-00			330 pF	Cer	500 V	5%
C778	281-0504-00	X2000		10 pF	Cer	500 V	10%
C781	281-0543-00			270 pF	Cer	500 V	10%
C783	283-0020-00			0.01 μF	Cer	500 V	
C784	281-0504-00	100	1999X	10 pF	Cer	500 V	10%
C786	281-0523-00	100	1999	100 pF	Cer	350 V	
C786	281-0504-00	2000		51 μF	Cer	500 V	5%
C789	283-0002-00	100	1999	0.01 μF	Cer	500 V	
C789	283-0000-00	2000		0.001 μF	Cer	500 V	
C795	283-0002-00	X2000		0.01 μF	Cer	500 V	
C796	283-0002-00	100	1999X	0.01 μF	Cer	500 V	
C797	283-0002-00	100	1999X	0.01 μF	Cer	500 V	
C799	281-0573-00	100	1999X	11 pF	Cer		10%
C804	283-0026-00			0.2 μF	Cer	25 V	
C811	290-0187-00			4.7 μF	Elect.	35 V	
C813	283-0002-00			0.01 μF	Cer	500 V	
C823	281-0543-00			270 pF	Cer	500 V	10%
C831	281-0513-00			27 pF	Cer	500 V	
C835	281-0518-00			47 pF	Cer	500 V	
C837	281-0523-00			100 pF	Cer	350 V	
C840	281-0542-00	X330		18 pF	Cer	500 V	10%
C843	283-0000-00			0.001 μF	Cer	500 V	
C848	281-0523-00			100 pF	Cer	350 V	

Capacitors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
C853	283-0002-00	X2000		0.01 μF	Cer	500 V	
C855	283-0002-00	X2000		0.01 μF	Cer	500 V	
C860A	*295-0099-00			10 μF	Timing Capacitor		
C860B				1 μF			
C860C				0.1 μF			
C860D				0.01 μF			
C860E				997.5 pF			
C860F	281-0574-00			82 pF	Cer	500 V	10%
C860G	281-0010-00			4.5-25 pF, Var	Cer		
C860H	281-0007-00			3-12 pF, Var	Cer		
C860J	281-0007-00			3-12 pF, Var	Cer		
C866	283-0001-00			0.005 μF	Cer	500 V	
C869	281-0528-00			82 pF	Cer	500 V	10%
C873	283-0002-00			0.01 μF	Cer	500 V	
C875A	285-0576-00			1 μF	PTM	100 V	10%
C875B	285-0633-00			0.22 μF	PTM	100 V	10%
C875C	285-0636-00			0.022 μF	PTM	200 V	
C875D	285-0543-00			0.0022 μF	MT	400 V	
C875E	281-0550-00			120 pF	Cer	500 V	10%
C876	281-0550-00			120 pF	Cer	500 V	10%
C881	281-0010-00			4.5-25 pF, Var	Cer		
C882	281-0010-00			4.5-25 pF, Var	Cer		
C888	283-0000-00			0.001 μF	Cer	500 V	
C894	283-0002-00			0.01 μF	Cer	500 V	
C896	283-0002-00			0.01 μF	Cer	500 V	
C897	283-0002-00			0.01 μF	Cer	500 V	
C901	281-0617-00			15 pF	Cer	200 V	
C902	283-0002-00			0.01 μF	Cer	500 V	
C905	283-0002-00			0.01 μF	Cer	500 V	
C910	283-0002-00			0.01 μF	Cer	500 V	
C911	285-0572-00			0.1 μF	PTM	200 V	
C924	281-0605-00			200 pF	Cer	500 V	
C926	283-0067-00			0.001 μF	Cer	200 V	10%
C935	283-0081-00			0.1 μF	Cer	25 V	+80%—20%
C1013	281-0523-00			100 pF	Cer	350 V	
C1018	281-0518-00			47 pF	Cer	500 V	
C1021	283-0000-00			0.001 μF	Cer	500 V	
C1023	281-0523-00			100 pF	Cer	350 V	
C1028	281-0541-00			6.8 pF	Cer	500 V	10%
C1041	281-0550-00			120 pF	Cer	500 V	10%
C1042	283-0002-00			0.01 μF	Cer	500 V	
C1051	281-0508-00			12 pF	Cer	500 V	
C1054	281-0508-00			12 pF	Cer	500 V	
C1061	281-0550-00			120 pF	Cer	500 V	10%
C1062	283-0002-00			0.01 μF	Cer	500 V	
C1065	283-0001-00			0.005 μF	Cer	500 V	
C1071	281-0508-00			12 pF	Cer	500 V	

Capacitors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
C1074	281-0508-00			12 pF	Cer	500 V	
C1100B	281-0031-00			3-12 pF, Var	Cer		
C1100D	281-0602-00			68 pF	Cer	500 V	5%
C1110	283-0001-00	X2000		0.005 μF	Cer	500 V	
C1112	283-0001-00			0.005 μF	Cer	500 V	
C1115	281-0010-00			4.5-25 pF, Var	Cer		
C1117	281-0547-00			2.7 pF,	Cer	500 V	10%
C1141	281-0549-00			68 pF	Cer	500 V	10%
C1144	283-0002-00			0.01 μF	Cer	500 V	
C1146	281-0549-00			68 pF	Cer	500 V	10%
C1165	281-0022-00			8-50 pF, Var	Cer		
C1169	283-0001-00			0.005 μF	Cer	500 V	
C1172	281-0022-00			8-50 pF, Var	Cer		
C1174	281-0053-00			0.35-1.37 pF, Var	Cer		
C1176	283-0001-00			0.005 μF	Cer	500 V	
C1182	281-0022-00			8-50 pF, Var	Cer		
C1184	281-0053-00			0.35-1.37 pF, Var	Cer		
C1186	283-0001-00			0.005 μF	Cer	500 V	
C1190	283-0002-00			0.01 μF	Cer	500 V	
C1193	281-0036-00			3-12 pF, Var	Cer		
C1195	283-0000-00			0.001 μF	Cer	500 V	
C1197	285-0628-00			0.033 μF	PTM	300 V	
C1200B	281-0007-00			3-12 pF, Var	Cer		
C1200D	281-0602-00			68 pF	Cer	500 V	5%
C1210	283-0001-00	X2000		0.005 μF	Cer	500 V	
C1212	283-0001-00			0.005 μF	Cer	500 V	
C1215	281-0010-00			4.5-25 pF, Var	Cer		
C1217	281-0547-00			2.7 pF	Cer	500 V	10%
C1241	281-0549-00			68 pF	Cer	500 V	10%
C1244	283-0002-00			0.01 μF	Cer	500 V	
C1246	281-0549-00			68 pF	Cer	500 V	10%
C1265	281-0022-00			8-50 pF, Var	Cer		
C1269	283-0001-00			0.005 μF	Cer	500 V	
C1272	281-0022-00			8-50 pF, Var	Cer		
C1274	281-0053-00			0.35-1.37 pF, Var	Cer		
C1276	283-0001-00			0.005 μF	Cer	500 V	
C1282	281-0022-00			8-50 pF, Var	Cer		
C1284	281-0053-00			0.35-1.37 pF, Var	Cer		
C1286	283-0001-00			0.005 μF	Cer	500 V	
C1290	283-0002-00			0.01 μF	Cer	500 V	
C1293	281-0036-00			3-12 pF, Var	Cer		
C1295	283-0000-00			0.001 μF	Cer	500 V	
C1297	285-0628-00			0.033 μF	PTM	300 V	
C1300	285-0526-00			0.1 μF	MT	400 V	
C1302	281-0523-00			100 pF	Cer	350 V	

Capacitors (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
C1303	283-0621-00			0.0027 μF	Mica	1000 V	5%
C1305	283-0002-00			0.01 μF	Cer	500 V	
C1311	281-0544-00			5.6 pF	Cer	500 V	10%
C1314	283-0082-00			0.01 μF	Cer	4000 V	+80%—20%
C1315	285-0622-00			0.1 μF	PTM	100 V	
C1316	283-0082-00			0.01 μF	Cer	4000 V	+80%—20%
C1321	283-0116-00			820 pF	Cer	500 V	5%
C1322	283-0082-00			0.01 μF	Cer	4000 V	+80%—20%
C1323	283-0082-00			0.01 μF	Cer	4000 V	+80%—20%
C1325	285-0576-00			1 μF	PTM	100 V	10%
C1326	281-0556-00			500 pF	Cer	10,000 V	
C1327	283-0096-00			500 pF	Cer	20,000 V	
C1328	283-0556-00			500 pF	Cer	10,000 V	
C1329	283-0071-00			0.0068 μF	Cer	5000 V	
C1330	283-0082-00			0.01 μF	Cer	4000 V	+80%—20%
C1331	283-0059-00			1 μF	Cer	25 V	+80%—20%
C1332	283-0082-00			0.01 μF	Cer	4000 V	+80%—20%
C1333	283-0001-00			0.005 μF	Cer	500 V	
C1334	283-0082-00			0.01 μF	Cer	4000 V	+80%—20%
C1342	283-0002-00			0.01 μF	Cer	500 V	
C1347	283-0082-00			0.01 μF	Cer	4000 V	+80%—20%
C1352	281-0523-00			100 pF	Cer	350 V	
C1353	283-0621-00			0.0027 μF	Mica	1000 V	5%
C1355	283-0002-00			0.01 μF	Cer	500 V	
C1361	281-0544-00			5.6 pF	Cer	500 V	10%
C1364	283-0082-00			0.01 μF	Cer	4000 V	+80%—20%
C1365	285-0622-00			0.1 μF	PTM	100 V	
C1366	283-0082-00			0.01 μF	Cer	4000 V	+80%—20%
C1371	283-0116-00			820 pF	Cer	500 V	5%
C1372	283-0082-00			0.01 μF	Cer	4000 V	+80%—20%
C1373	283-0082-00			0.01 μF	Cer	4000 V	+80%—20%
C1376	285-0526-00			0.1 μF	MT	400 V	
C1378	283-0082-00			0.01 μF	Cer	4000 V	+80%—20%
C1382	283-0082-00			0.01 μF	Cer	4000 V	+80%—20%
C1383	283-0001-00			0.005 μF	Cer	500 V	
C1384	283-0082-00			0.01 μF	Cer	4000 V	+80%—20%
C1391	283-0002-00			0.01 μF	Cer	500 V	
C1392	283-0002-00			0.01 μF	Cer	500 V	
C1397	283-0082-00			0.01 μF	Cer	4000 V	+80%—20%
C1400	*285-0672-00	X2047		0.1 μF	MT	600 V	+5%—15%
C1404	285-0718-00			3.75 μF	PTM		10%
C1412	290-0173-00			200 μF	Elect.	250 V	
C1413	290-0303-00	X2000		5 μF	Elect.	300 V	+75%—10%
C1414	283-0067-00	100	1999X	0.001 μF	Cer	200 V	10%
C1421	285-0566-00	100	1999	0.022 μF	PTM	200 V	10%
C1421	285-0572-00	2000		0.1 μF	PTM	200 V	

Capacitors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
C1424A,B,C,D	290-0294-00			10x10x20x40 μF	Elect.	300/400/200/400 V	
C1426A,B,C,D	290-0294-00			10x10x20x40 μF	Elect.	300/400/200/400 V	
C1432	290-0169-00			400 μF	Elect.	250 V	
C1433	285-0572-00			0.1 μF	PTM	200 V	
C1434	283-0001-00			0.005 μF	Cer	500 V	
C1435	290-0303-00			5 μF	Elect.	300 V	+75%—10%
C1436	290-0266-00			290 μF	Elect.	15 V	
C1437	283-0001-00	100	1999X	0.005 μF	Cer	500 V	
C1448	285-0519-00			0.047 μF	MT	400 V	
C1450	285-0526-00			0.1 μF	MT	400 V	
C1451	290-0169-00			400 μF	Elect.	250 V	
C1452	290-0169-00			400 μF	Elect.	250 V	
C1453	285-0572-00			0.1 μF	PTM	200 V	
C1454	283-0001-00			0.005 μF	Cer	500 V	
C1458	290-0303-00			5 μF	Elect.	300 V	+75%—10%
C1462	285-0519-00			0.047 μF	MT	400 V	
C1482	290-0180-00			300 μF	Elect.	250 V	
C1488	283-0067-00	100	1999	0.001 μF	Cer	200 V	10%
C1488	283-0001-00	2000		0.005 μF	Cer	500 V	
C1498	290-0214-00			10 μF	Elect.	250 V	
C1499	290-0214-00			10 μF	Elect.	250 V	
C1500	283-0001-00			0.005 μF	Cer	500 V	
C1501	285-0572-00			0.1 μF	PTM	200 V	
C1507	285-0519-00			0.047 μF	MT	400 V	
C1530	283-0002-00			0.01 μF	Cer	500 V	
C1540	283-0002-00			0.01 μF	Cer	500 V	
C1550	283-0068-00			0.01 μF	Cer	500 V	
C1552A,B,C	290-0072-00			20x20x40 μF	Elect.	475 V	
C1553	283-0068-00			0.01 μF	Cer	500 V	
C1556	283-0068-00			0.01 μF	Cer	500 V	
C1559	283-0068-00			0.01 μF	Cer	500 V	
C1562	290-0012-00			2x40 μF	Elect.	250 V	
C1563	283-0068-00			0.01 μF	Cer	500 V	
C1580	283-0068-00			0.01 μF	Cer	500 V	
C1582A,B,C	290-0072-00			20x20x40x μF	Elect.	475 V	
C1583	283-0068-00			0.01 μF	Cer	500 V	
C1586	283-0068-00			0.01 μF	Cer	500 V	
C1589	283-0068-00			0.01 μF	Cer	500 V	
C1592	290-0012-00			2x40 μF	Elect.	250 V	
C1593	283-0068-00			0.01 μF	Cer	500 V	
C1602	285-0572-00			0.1 μF	PTM	200 V	
C1604	283-0002-00			0.01 μF	Cer	500 V	
C1605	283-0524-00			750 pF	Cer	500 V	5%
C1615	283-0524-00			750 pF	Cer	500 V	5%
C1616	283-0002-00			0.01 μF	Cer	500 V	

Capacitors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
C1624	285-0572-00			0.1 μF	PTM	200 V
C1640	281-0525-00			470 pF	Cer	500 V
C1650	281-0523-00			100 pF	Cer	350 V

Diodes

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description	
D2	*152-0107-00	X830		Silicon	Replaceable by 1N647
D4	*152-0185-00			Silicon	Replaceable by 1N3605
D6	152-0229-00			Zener	1N3034B 1 W, 39 V, 5%
D7	152-0243-00	100	829X	Zener	1N965B 0.4 W, 15 V, 5%
D8	*152-0185-00			Silicon	Replaceable by 1N3605
D9	*152-0185-00	X830		Silicon	Replaceable by 1N3605
D15	*152-0153-00			Silicon	Replaceable by 1N4244
D16	*152-0153-00			Silicon	Replaceable by 1N4244
D17	*152-0153-00			Silicon	Replaceable by 1N4244
D19	*152-0153-00			Silicon	Replaceable by 1N4244
D26	152-0265-00			Zener	1N970B 0.4 W, 24 V, 5%
D34	*152-0185-00	X830		Silicon	Replaceable by 1N3605
D87	152-0168-00			Zener	1N963A 0.4 W, 12 V, 20%
D102	*152-0107-00	X830		Silicon	Replaceable by 1N647
D104	*152-0185-00			Silicon	Replaceable by 1N3605
D108	*152-0185-00			Silicon	Replaceable by 1N3605
D109	*152-0185-00	X830		Silicon	Replaceable by 1N3605
D115	*152-0153-00			Silicon	Replaceable by 1N4244
D116	*152-0153-00			Silicon	Replaceable by 1N4244
D117	*152-0153-00			Silicon	Replaceable by 1N4244
D119	*152-0153-00			Silicon	Replaceable by 1N4244
D134	*152-0185-00	X830		Silicon	Replaceable by 1N3605
D144	152-0119-00			Zener	1N969A 0.4 W, 22 V, 10%
D146	152-0168-00			Zener	1N963A 0.4 W, 12 V, 20%
D202	*152-0107-00	X830		Silicon	Replaceable by 1N647
D204	*152-0185-00			Silicon	Replaceable by 1N3605
D206	152-0229-00			Zener	1N3034B 1 W, 39 V, 5%
D207	152-0243-00	100	829X	Zener	1N965B 0.4 W, 15 V, 5%
D208	*152-0185-00			Silicon	Replaceable by 1N3605
D209	*152-0185-00	X830		Silicon	Replaceable by 1N3605
D224	152-0119-00			Zener	1N969A 0.4 W, 22 V, 10%
D278	152-0168-00			Zener	1N963A 0.4 W, 12 V, 20%
D402	*152-0107-00	X830		Silicon	Replaceable by 1N647
D404	*152-0185-00			Silicon	Replaceable by 1N3605
D408	*152-0185-00			Silicon	Replaceable by 1N3605
D409	*152-0185-00	X830		Silicon	Replaceable by 1N3605
D424	152-0168-00			Zener	1N963A 0.4 W, 12 V, 20%
D442	152-0120-00			Zener	1N3020B 1 W, 10 V, 5%
D555	152-0154-00			Tunnel	TD253 10 mA
D560	*152-0185-00			Silicon	Replaceable by 1N3605

Diodes *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description	
D561	*152-0185-00			Silicon	Replaceable by 1N3605
D562	*152-0075-00			Germanium	Tek Spec
D565	*152-0125-00			Tunnel	Selected TD3A
D570	*152-0185-00			Silicon	Replaceable by 1N3605
D574	*152-0061-00			Silicon	Tek Spec
D578	*152-0061-00	100	1999X	Silicon	Tek Spec
D581	*152-0061-00			Silicon	Tek Spec
D589	*152-0107-00	X2000		Silicon	Replaceable by 1N647
D602	*152-0185-00			Silicon	Replaceable by 1N3605
D604	*152-0185-00			Silicon	Replaceable by 1N3605
D612	152-0119-00			Zener	1N969A 0.4 W, 22 V, 10%
D614	*152-0185-00			Silicon	Replaceable by 1N3605
D616	*152-0153-00			Silicon	Replaceable by 1N4244
D624	*152-0185-00			Silicon	Replaceable by 1N3605
D627	*152-0185-00			Silicon	Replaceable by 1N3605
D629	*152-0185-00			Silicon	Replaceable by 1N3605
D635	*152-0185-00			Silicon	Replaceable by 1N3605
D640	*152-0161-00			GaAs	Tek Spec
D641	*152-0165-00			Silicon	Selected from 1N3579
D675	152-0118-00			Zener	1N3033 1 W, 36 V, 20%
D677	*152-0061-00			Silicon	Tek Spec
D678	*152-0061-00			Silicon	Tek Spec
D681	*152-0061-00			Silicon	Tek Spec
D690	*152-0061-00			Silicon	Tek Spec
D755	152-0154-00			Tunnel	TD253 10 mA
D760	*152-0185-00			Silicon	Replaceable by 1N3605
D761	*152-0185-00			Silicon	Replaceable by 1N3605
D762	*152-0075-00			Germanium	Tek Spec
D765	*152-0125-00			Tunnel	Selected TD3A
D770	*152-0185-00			Silicon	Replaceable by 1N3605
D774	*152-0061-00			Silicon	Tek Spec
D778	*152-0061-00			Silicon	Tek Spec
D781	*152-0061-00			Silicon	Tek Spec
D788	*152-0061-00	X2000		Silicon	Tek Spec
D789	*152-0061-00	X2000		Silicon	Tek Spec
D790	*152-0061-00	X2000		Silicon	Tek Spec
D792	*152-0185-00	X2000		Silicon	Replaceable by 1N3605
D796	*152-0185-00	100	1999	Silicon	Replaceable by 1N3605
D796	152-0147-00	2000		Zener	1N971B 0.4 W, 27 V, 5%
D797	152-0147-00	100	1999X	Zener	1N971B 0.4 W, 27 V, 5%
D799	*152-0185-00	100	1999	Silicon	Replaceable by 1N3605
D799	*152-0061-00	2000		Silicon	Tek Spec
D802	*152-0185-00			Silicon	Replaceable by 1N3605
D804	*152-0185-00			Silicon	Replaceable by 1N3605
D812	152-0119-00			Zener	1N969A 0.4 W, 22 V, 10%

Diodes *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description	
D814	*152-0185-00			Silicon	Replaceable by 1N3605
D816	*152-0153-00			Silicon	Replaceable by 1N4244
D824	*152-0185-00			Silicon	Replaceable by 1N3605
D827	*152-0185-00			Silicon	Replaceable by 1N3605
D829	*152-0185-00			Silicon	Replaceable by 1N3605
D835	*152-0185-00			Silicon	Replaceable by 1N3605
D838	*152-0185-00	X2000		Silicon	Replaceable by 1N3605
D840	*152-0161-00			GaAs	Tek Spec
D841	*152-0165-00			Silicon	Selected from 1N3579
D850	*152-0061-00	X2000		Silicon	Tek Spec
D852	*152-0185-00	X2000		Silicon	Replaceable by 1N3605
D856	152-0147-00	X2000		Zener	1N971B 0.4 W, 27 V, 5%
D859	*152-0061-00	X2000		Silicon	Tek Spec
D875	152-0118-00			Zener	1N3033 1 W, 36 V, 20%
D877	*152-0061-00			Silicon	Tek Spec
D878	*152-0061-00			Silicon	Tek Spec
D881	*152-0061-00			Silicon	Tek Spec
D890	*152-0061-00			Silicon	Tek Spec
D905	152-0081-00			Tunnel	1N3714 2.2 mA
D1008	*152-0185-00			Silicon	Replaceable by 1N3605
D1010	*152-0185-00			Silicon	Replaceable by 1N3605
D1013	*152-0185-00			Silicon	Replaceable by 1N3605
D1014	*152-0185-00			Silicon	Replaceable by 1N3605
D1018	*152-0075-00			Germanium	Tek Spec
D1021	*152-0185-00			Silicon	Replaceable by 1N3605
D1023	*152-0185-00			Silicon	Replaceable by 1N3605
D1024	*152-0185-00			Silicon	Replaceable by 1N3605
D1028	*152-0075-00			Germanium	Tek Spec
D1042	*152-0185-00			Silicon	Replaceable by 1N3605
D1062	*152-0185-00			Silicon	Replaceable by 1N3605
D1144	152-0022-00			Zener	1M25Z5 1 W, 25 V, 5%
D1151	*152-0185-00			Silicon	Replaceable by 1N3605
D1160	*152-0185-00			Silicon	Replaceable by 1N3605
D1182	*152-0061-00			Silicon	Tek Spec
D1244	152-0022-00			Zener	1M25Z5 1 W, 25 V, 5%
D1251	*152-0185-00			Silicon	Replaceable by 1N3605
D1260	*152-0185-00			Silicon	Replaceable by 1N3605
D1282	*152-0061-00			Silicon	Tek Spec
D1303	*152-0107-00	X2000		Silicon	Replaceable by 1N647
D1322	152-0192-00			Silicon	7701-5X Varo
D1332	152-0192-00			Silicon	7701-5X Varo
D1334	*152-0165-00			Silicon	Selected from 1N3579
D1335	*152-0165-00			Silicon	Selected from 1N3579
D1372	152-0192-00			Silicon	7701-5X Varo
D1379	*152-0107-00	X2000		Silicon	Replaceable by 1N647

Diodes *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc		Description
D1382	152-0192-00			Silicon	7701-5X Varo
D1412A,B,C,D (4)	152-0066-00			Silicon	1N3194
D1414	*152-0107-00			Silicon	Replaceable by 1N647
D1416	*152-0107-00	X2000		Silicon	Replaceable by 1N647
D1420	*152-0107-00	X2000		Silicon	Replaceable by 1N647
D1424	152-0066-00	100	1999X	Silicon	1N3194
D1425	152-0066-00	X2000		Silicon	1N3194
D1429	*152-0107-00	100	1999X	Silicon	Replaceable by 1N647
D1430	*152-0107-00			Silicon	Replaceable by 1N647
D1431	*152-0107-00	X2000		Silicon	Replaceable by 1N647
D1432A,B,C,D (4)	152-0066-00			Silicon	1N3194
D1433	*152-0107-00	X2000		Silicon	Replaceable by 1N647
D1434	152-0066-00			Silicon	1N3194
D1435	*152-0107-00	X2000		Silicon	Replaceable by 1N647
D1436	152-0066-00			Silicon	1N3194
D1440	152-0066-00			Silicon	1N3194
D1443	152-0066-00	100	1999X	Silicon	1N3194
D1444	*152-0107-00	100	1999X	Silicon	Replaceable by 1N647
D1449	*152-0107-00			Silicon	Replaceable by 1N647
D1450	*152-0107-00			Silicon	Replaceable by 1N647
D1451	*152-0107-00	X2000		Silicon	Replaceable by 1N647
D1452A,B,C,D (4)	*152-0198-00			Silicon	MR-1032A (Motorola)
D1453	*152-0107-00	X2000		Silicon	Replaceable by 1N647
D1455	*152-0107-00	X2000		Silicon	Replaceable by 1N647
D1464	*152-0107-00			Silicon	Replaceable by 1N647
D1466	*152-0107-00	100	1999X	Silicon	Replaceable by 1N647
D1469	*152-0107-00	100	1999X	Silicon	Replaceable by 1N647
D1472	152-0066-00	100	1999X	Silicon	1N3194
D1482A,B,C,D (4)	152-0066-00			Silicon	1N3194
D1501	*152-0107-00	X2000		Silicon	Replaceable by 1N647
D1515	*152-0107-00			Silicon	Replaceable by 1N647
D1517	*152-0107-00	100	1999X	Silicon	Replaceable by 1N647
D1620	*152-0061-00			Silicon	Tek Spec

Filter

FL1400	119-0071-00	100	1999	275 V AC
FL1400	119-0135-00	2000	2046	275 V AC
FL1400	119-0135-00	2047		275 V AC

Fuses

F1401	159-0057-00	10 A 3AG Slo-Blo
F1402	159-0006-00	5 A 3AG Slo-Blo
F1424	159-0042-00	0.75 A 3AG Fast-Blo
F1446	159-0016-00	1.5 A 3AG Fast-Blo
F1478	159-0022-00	1 A 3AG Fast-Blo
F1482	159-0042-00	0.75 A 3AG Fast-Blo

Connectors

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
J11	131-0018-00			Coaxial, 16 contact
J12	131-0018-00			Coaxial, 16 contact
J525	131-0106-01			Coaxial, 1 contact, BNC
J590	131-0106-01			Coaxial, 1 contact, BNC
J692	131-0106-01			Coaxial, 1 contact, BNC
J725	131-0106-01			Coaxial, 1 contact, BNC
J790	131-0106-01			Coaxial, 1 contact, BNC
J892	131-0106-01			Coaxial, 1 contact, BNC
J935	131-0106-01			Coaxial, 1 contact, BNC
J1100	131-0106-01			Coaxial, 1 contact, BNC
J1200	131-0106-01			Coaxial, 1 contact, BNC
J1345	131-0106-01			Coaxial, 1 contact, BNC
J1395	131-0106-01			Coaxial, 1 contact, BNC
J1400	*131-0150-00			3 wire motor base, male
J1650	131-0274-00			BNC, chassis mtd.

Inductors

Ckt. No.	Tektronix Part No.	Eff	Disc	Description	
L18	*108-0396-00			0.14 μH	
L22	276-0554-00			Core, Toroid Ferrite	
L40	*119-0069-00			Delay Line	
L43	*114-0211-00			250-370 nH, Var	Core 276-0506-00
L64	*114-0213-00			5-10 μH, Var	Core 276-0506-00
L77	*108-0056-00			1.2 μH	
L118	*108-0396-00			0.14 μH	
L122	276-0554-00			Core, Toroid Ferrite	
L143	*114-0211-00			250-370 nH, Var	Core 276-0506-00
L164	*114-0213-00			5-10 μH, Var	Core 276-0506-00
L177	*108-0056-00			1.2 μH	
L218	*108-0396-00			0.14 μH	
L220	*119-0069-00			Delay Line	
L224	*114-0211-00			250-370 nH, Var	Core 276-0506-00
L254	*114-0212-00			5-10 μH, Var	Core 276-0506-00
L267	*108-0056-00			1.2 μH	
L418	*108-0396-00			0.14 μH	
L424	*114-0211-00			250-370 nH, Var	Core 276-0506-00
L454	*114-0212-00			5-10 μH, Var	Core 276-0506-00
L467	*108-0056-00			1.2 μH	
L547	*108-0355-00			Coil, Reed	
L552	276-0507-00			Core, Ferramic Suppressor	
L555	*108-0147-01			2.2 μH	
L560	*108-0215-00			1.1 μH	
L747	*108-0355-00			Coil, Reed	

Inductors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
L752	276-0507-00			Core, Ferramic Suppressor
L755	*108-0147-01			2.2 μH
L760	*108-0215-00			1.1 μH
L1125	*108-0355-00			Coil, Reed
L1225	*108-0355-00			Coil, Reed
L1346	*108-0016-00			29 μH
L1390	*108-0296-00			Beam Rotator
L1396	*108-0016-00			29 μH
LR44	*108-0397-00	100	829	1.2 μH (wound on a 24 Ω, 1/2 W, 5% resistor)
LR44	*108-0454-00	830		1.1 μH (wound on a 24 Ω, 1/2 W, 5% resistor)
LR144	*108-0397-00	100	829	1.2 μH (wound on a 24 Ω, 1/2 W, 5% resistor)
LR144	*108-0454-00	830		1.1 μH (wound on a 24 Ω, 1/2 W, 5% resistor)
LR228	*108-0397-00	100	829	1.2 μH (wound on a 24 Ω, 1/2 W, 5% resistor)
LR228	*108-0454-00	830		1.1 μH (wound on a 24 Ω, 1/2 W, 5% resistor)
LR428	*108-0397-00	100	829	1.2 μH (wound on a 24 Ω, 1/2 W, 5% resistor)
LR428	*108-0454-00	830		1.1 μH (wound on a 24 Ω, 1/2 W, 5% resistor)

Transistors

Ckt. No.	Tektronix Part No.	Eff	Disc	Description	
Q3	*151-0185-00			Germanium	Selected from 2N2929
Q14	*151-0185-00			Germanium	Selected from 2N2929
Q23	*151-0109-00			Silicon	Selected from 2N918
Q34	*151-0185-00			Germanium	Selected from 2N2929
Q43	*151-0109-00			Silicon	Selected from 2N918
Q44	*151-0185-00			Germanium	Selected from 2N2929
Q54	151-0160-00			Silicon	2N3137
Q73	151-0190-00			Silicon	2N3904
Q74	*151-0188-01			Silicon	Replaceable by 2N3251
Q83	151-0190-00			Silicon	2N3904
Q84	151-0087-00			Silicon	2N1131
Q93	151-0190-00			Silicon	2N3904
Q94	151-0087-00			Silicon	2N1131
Q103	*151-0185-00			Germanium	Selected from 2N2929
Q114	*151-0185-00			Germanium	Selected from 2N2929
Q123	*151-0109-00			Silicon	Selected from 2N918
Q134	*151-0185-00			Germanium	Selected from 2N2929
Q143	*151-0109-00			Silicon	Selected from 2N918
Q144	*155-0185-00			Germanium	Selected from 2N2929
Q154	151-0160-00			Silicon	2N3137
Q173	151-0190-00			Silicon	2N3904
Q174	*151-0188-01			Silicon	Replaceable by 2N3251
Q203	*151-0185-00			Germanium	Selected from 2N2929
Q214	*151-0185-00			Germanium	Selected from 2N2929
Q224	*151-0185-00			Germanium	Selected from 2N2929

Transistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description	
Q233	*151-0109-00			Silicon	Selected from 2N918
Q244	151-0160-00			Silicon	2N3137
Q263	151-0190-00			Silicon	2N3904
Q264	*151-0188-01			Silicon	Replaceable by 2N3251
Q273	151-0190-00			Silicon	2N3904
Q274	151-0087-00			Silicon	2N1131
Q283	151-0190-00			Silicon	2N3904
Q284	151-0087-00			Silicon	2N1131
Q403	*151-0185-00			Germanium	Selected from 2N2929
Q414	*151-0185-00			Germanium	Selected from 2N2929
Q424	*151-0185-00			Germanium	Selected from 2N2929
Q433	*151-0109-00			Silicon	Selected from 2N918
Q444	151-0160-00			Silicon	2N3137
Q463	151-0190-00			Silicon	2N3904
Q464	*151-0188-01			Silicon	Replaceable by 2N3251
Q544	151-0188-00			Silicon	2N3906
Q554	151-0188-00			Silicon	2N3906
Q563	151-0188-00			Silicon	2N3906
Q564	151-0190-00			Silicon	2N3904
Q573	151-0190-00			Silicon	2N3904
Q605	151-0190-00			Silicon	2N3904
Q615	151-0190-00			Silicon	2N3904
Q619	*151-0154-00			Silicon	Replaceable by 2N2924
Q643	*151-0188-01			Silicon	Replaceable by 2N3251
Q744	151-0188-00			Silicon	2N3906
Q754	151-0188-00			Silicon	2N3906
Q763	151-0188-00			Silicon	2N3906
Q764	151-0190-00			Silicon	2N3904
Q773	151-0190-00			Silicon	2N3904
Q779	*151-0188-01	100	1999X	Silicon	Replaceable by 2N3251
Q793	*151-0188-01	100	1999X	Silicon	Replaceable by 2N3251
Q794	151-0190-00	X2000		Silicon	2N3904
Q805	151-0190-00			Silicon	2N3904
Q815	151-0190-00			Silicon	2N3904
Q819	*151-0154-00			Silicon	Replaceable by 2N2924
Q843	*151-0188-01			Silicon	Replaceable by 2N3251
Q854	151-0190-00	X2000		Silicon	2N3904
Q908	151-0150-00			Silicon	2N3440
Q924	151-0188-00			Silicon	2N3906
Q933	151-0190-00			Silicon	2N3904
Q1004	151-0188-00			Silicon	2N3906
Q1015	151-0188-00			Silicon	2N3906
Q1025	151-0188-00			Silicon	2N3906
Q1033	151-0190-00			Silicon	2N3904
Q1135	*151-0121-00			Silicon	Selected from 2N3118

Transistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc		Description
Q1145	*151-0096-00			Silicon	Selected from 2N1893
Q1154	151-0063-00	100	1999	Germanium	2N2207
Q1154	*151-0133-00	2000		Silicon	Selected from 2N3251
Q1164	151-0063-00	100	1999	Germanium	2N2207
Q1164	*151-0133-00	2000		Silicon	Selected from 2N3251
Q1235	*151-0121-00			Silicon	Selected from 2N3118
Q1245	*151-0096-00			Silicon	Selected from 2N1893
Q1254	151-0063-00	100	1999	Germanium	2N2207
Q1254	*151-0133-00	2000		Silicon	Selected from 2N3251
Q1264	151-0063-00	100	1999	Germanium	2N2207
Q1264	*151-0133-00	2000		Silicon	Selected from 2N3251
Q1334	*151-0192-00			Silicon	Replaceable by MPS 6521
Q1414	*151-0096-00			Silicon	Selected from 2N1893
Q1424	151-0188-00			Silicon	2N3906
Q1427	*151-0158-00	100	1999	Germanium	Replaceable by DTG 2400
Q1427	151-0218-00	2000		Silicon	2N4348
Q1434	*151-0136-00			Silicon	Replaceable by 2N3053
Q1443	*151-0096-00			Silicon	Selected from 2N1893
Q1444	*151-0149-00			Silicon	Selected from 2N3441
Q1447	*151-0158-00	100	1999	Germanium	Replaceable by DTG 2400
Q1447	151-0218-00	2000		Silicon	2N4348
Q1454	*151-0136-00			Silicon	Replaceable by 2N3053
Q1463	*151-0096-00			Silicon	Selected from 2N1893
Q1464	*151-0149-00			Silicon	Selected from 2N3441
Q1467	*151-0158-00	100	1999	Germanium	Replaceable by DTG 2400
Q1467	151-0218-00	2000		Silicon	2N4348
Q1477	*151-0158-00	100	1999	Germanium	Replaceable by DTG 2400
Q1477	151-0218-00	2000		Silicon	2N4348
Q1484	151-0151-00			Silicon	Replaceable by 2N930
Q1494	151-0151-00			Silicon	Replaceable by 2N930
Q1504	*151-0096-00			Silicon	Selected from 2N1893
Q1513	*151-0149-00			Silicon	Selected from 2N3441
Q1517	*151-0158-00	100	1999	Germanium	Replaceable by DTG 2400
Q1517	151-0218-00	2000		Silicon	2N4348

Resistors

Resistors are fixed, composition, ±10% unless otherwise indicated.

R1	315-0220-00			22 Ω	¼ W		5%
R2	315-0101-00	100	829	100 Ω	¼ W		5%
R2	308-0301-00	830		10 kΩ	3 W	WW	1%
R3	315-0101-00	X830		100 Ω	¼ W		5%
R4	305-0682-00			6.8 kΩ	2 W		5%

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R5	311-0395-00			2.5 kΩ, Var			
R6	323-0206-00			1.37 kΩ	½ W	Prec	1%
R7	308-0329-00			4 kΩ	3 W	WW	2%
R8	305-0153-00			15 kΩ	2 W		5%
R9	321-0129-00			215 Ω	⅛ W	Prec	1%
R10	315-0101-00	X830		100 Ω	¼ W		5%
R11	315-0471-00			470 Ω	¼ W		5%
R12	311-0433-00			100 Ω, Var			
R13	315-0300-00			30 Ω	¼ W		5%
R14	323-0118-00			165 Ω	½ W	Prec	1%
R16	321-0114-00			150 Ω	⅛ W	Prec	1%
R18	321-0123-00			187 Ω	⅛ W	Prec	1%
R20	321-0094-00			93.1 Ω	⅛ W	Prec	1%
R22	321-0093-00			90.9 Ω	⅛ W	Prec	1%
R23	301-0242-00			2.4 kΩ	½ W		5%
R24	315-0101-00			100 Ω	¼ W		5%
R25	315-0431-00			430 Ω	¼ W		5%
R26	308-0306-00			3.26 kΩ	3 W	WW	2%
R30	315-0101-00			100 Ω	¼ W		5%
R31	311-0463-00			5 kΩ, Var			
R32	321-0287-00	100	829	9.53 kΩ	⅛ W	Prec	1%
R32	315-0223-00	830		22 kΩ	¼ W		5%
R33	315-0300-00			30 Ω	¼ W		5%
R34	311-0433-00			100 Ω, Var			
R35	315-0471-00			470 Ω	¼ W		5%
R36	321-0129-00			215 Ω	⅛ W	Prec	1%
R37	303-0393-00			39 kΩ	1 W		5%
R39	321-0107-00			127 Ω	⅛ W	Prec	1%
R40	315-0432-00			4.3 kΩ	¼ W		5%
R41	321-0092-00			88.7 Ω	⅛ W	Prec	1%
R42	321-0114-00			150 Ω	⅛ W	Prec	1%
R43	321-0143-00			301 Ω	⅛ W	Prec	1%
R44	316-0220-00			22 Ω	¼ W		
R45	308-0291-00			2 kΩ	3 W	WW	5%
R46	316-0101-00			100 Ω	¼ W		
R47	308-0304-00			1.5 kΩ	3 W	WW	1%
R48	323-0239-00			3.01 kΩ	½ W	Prec	1%
R49	315-0153-00	100	829	15 kΩ	¼ W		5%
R49	315-0123-00	830		12 kΩ	¼ W		5%
R50	321-0221-00	100	829	1.96 kΩ	⅛ W	Prec	1%
R50	321-0213-00	830		1.62 kΩ	⅛ W	Prec	1%
R52	311-0442-00			250 Ω, Var			
R54	311-0433-00			100 Ω, Var			
R55	321-0201-00			1.21 kΩ	⅛ W	Prec	1%
R56	323-0051-00			33.2 Ω	½ W	Prec	1%

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R58	301-0470-00			47 Ω	½ W		5%
R59	303-0472-00			4.7 kΩ	1 W		5%
R60	315-0473-00			47 kΩ	¼ W		5%
R62	308-0077-00			1 kΩ	3 W	WW	
R64	*310-0631-00			1 kΩ	3 W	Prec	1%
R65	315-0270-00	100	829	27 Ω	¼ W		5%
R65	315-0390-00	830		39 Ω	¼ W		5%
R66	315-0470-00			47 Ω	¼ W		5%
R67	323-0341-00			34.8 kΩ	½ W	Prec	1%
R68	323-0350-00	100	829	43.2 kΩ	½ W	Prec	1%
R68	323-0348-00	830		41.2 kΩ	½ W	Prec	1%
R69	311-0326-00			10 kΩ, Var			
R70	315-0221-00			220 Ω	¼ W		5%
R71	305-0152-00			1.5 kΩ	2 W		5%
R72	316-0220-00			22 Ω	¼ W		
R73	315-0820-00			82 Ω	¼ W		5%
R74	315-0820-00			82 Ω	¼ W		5%
R75	308-0329-00			4 kΩ	3 W	WW	2%
R77	323-0170-00			576 Ω	½ W	Prec	1%
R78	308-0406-00			1.2 kΩ	3 W	WW	1%
R79	315-0101-00			100 Ω	¼ W		5%
R80	324-0327-00			24.9 kΩ	1 W	Prec	1%
R81	323-0295-00			11.5 kΩ	½ W	Prec	1%
R82	307-0107-00			5.6 Ω	¼ W		5%
R83	302-0473-00			47 kΩ	½ W		
R84	315-0100-00			10 Ω	¼ W		5%
R85	305-0821-00			820 Ω	2 W		5%
R87	305-0391-00			390 Ω	2 W		5%
R88	315-0101-00			100 Ω	¼ W		5%
R89	303-0682-00			6.8 kΩ	1 W		5%
R90	308-0253-00			1.32 kΩ	3 W	WW	5%
R91	323-0291-00			10.5 kΩ	½ W	Prec	1%
R92	324-0327-00			24.9 kΩ	1 W	Prec	1%
R93	315-0120-00			12 Ω	¼ W		5%
R94	316-0100-00			10 Ω	¼ W		
R95	302-0473-00			47 kΩ	½ W		
R96	316-0100-00			10 Ω	¼ W		
R97	305-0821-00			820 Ω	2 W		5%
R99	305-0471-00			470 Ω	2 W		5%
R100	315-0820-00			82 Ω	¼ W		5%
R101	315-0220-00			22 Ω	¼ W		5%
R102	316-0474-00	100	829	470 kΩ	¼ W		
R102	308-0301-00	830		10 kΩ	3 W	WW	1%
R104	305-0682-00			6.8 kΩ	2 W		5%
R106	315-0100-00			10 Ω	¼ W		5%

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R108	321-0123-00			187 Ω	1/8 W	Prec	1%
R109	321-0129-00			215 Ω	1/8 W	Prec	1%
R110	315-0101-00	X830		100 Ω	1/4 W		5%
R113	315-0300-00			30 Ω	1/4 W		5%
R114	323-0118-00			165 Ω	1/2 W	Prec	1%
R115	303-0393-00			39 kΩ	1 W		5%
R116	321-0114-00			150 Ω	1/8 W	Prec	1%
R120	321-0094-00			93.1 Ω	1/8 W	Prec	1%
R122	321-0093-00			90.9 Ω	1/8 W	Prec	1%
R125	315-0431-00			430 Ω	1/4 W		5%
R133	315-0300-00			30 Ω	1/4 W		5%
R136	321-0129-00			215 Ω	1/8 W	Prec	1%
R139	321-0107-00			127 Ω	1/8 W	Prec	1%
R140	315-0432-00			4.3 kΩ	1/4 W		5%
R141	321-0092-00			88.7 Ω	1/8 W	Prec	1%
R142	321-0114-00			150 Ω	1/8 W	Prec	1%
R143	321-0143-00			301 Ω	1/8 W	Prec	1%
R144	316-0220-00			22 Ω	1/4 W		
R145	316-0101-00			100 Ω	1/4 W		
R146	301-0123-00			12 kΩ	1/2 W		5%
R147	317-0511-00	X830		510 Ω	1/8 W		5%
R148	323-0239-00			3.01 kΩ	1/2 W	Prec	1%
R150	308-0218-00			150 Ω	3 W	WW	5%
R151	308-0337-00			200 Ω	7 W	WW	5%
R153	305-0202-00			2 kΩ	2 W		5%
R156	323-0051-00			33.2 Ω	1/2 W	Prec	1%
R158	301-0470-00			47 Ω	1/2 W		5%
R159	303-0472-00			4.7 kΩ	1 W		5%
R160	315-0473-00			47 kΩ	1/4 W		5%
R162	308-0077-00			1 kΩ	3 W	WW	
R164	*310-0631-00			1 kΩ	6 W	Prec	1%
R165	315-0270-00	100	829	27 Ω	1/4 W		5%
R165	315-0390-00	830		39 Ω	1/4 W		5%
R166	315-0470-00			47 Ω	1/4 W		5%
R167	305-0822-00	100	829	8.2 kΩ	2 W		5%
R167	305-0432-00	830		4.3 kΩ	2 W		5%
R170	315-0221-00			220 Ω	1/4 W		5%
R172	316-0220-00			22 Ω	1/4 W		
R173	315-0820-00			82 Ω	1/4 W		5%
R174	315-0820-00			82 Ω	1/4 W		5%
R175	308-0329-00			4 kΩ	3 W	WW	2%
R177	323-0170-00			576 Ω	1/2 W	Prec	1%
R180	323-0329-00			26.1 kΩ	1/2 W	Prec	1%
R182[1]	311-0595-00			10 kΩ, Var			

[1]Furnished as a unit with R1390A,B.

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R184	323-0329-00			26.1 kΩ	½ W	Prec	1%
R187	302-0100-00			10 Ω	½ W		
R201	315-0220-00			22 Ω	¼ W		5%
R202	315-0101-00	100	829	100 Ω	¼ W		5%
R202	308-0301-00	830		10 kΩ	3 W	WW	1%
R203	315-0101-00	X830		100 Ω	¼ W		5%
R204	305-0682-00			6.8 kΩ	2 W		5%
R205	311-0395-00			2.5 kΩ, Var			
R206	302-0683-00			68 kΩ	½ W		
R207	315-0101-00	X830		100 Ω	¼ W		5%
R209	321-0129-00			215 Ω	⅛ W	Prec	1%
R211	315-0471-00			470 Ω	¼ W		5%
R212	311-0433-00			100 Ω, Var			
R213	315-0300-00			30 Ω	¼ W		5%
R214	323-0118-00			165 Ω	½ W	Prec	1%
R216	321-0122-00			182 Ω	⅛ W	Prec	1%
R218	321-0123-00			187 Ω	⅛ W	Prec	1%
R222	321-0092-00			88.7 Ω	⅛ W	Prec	1%
R224	316-0101-00			100 Ω	¼ W		
R225	321-0114-00			150 Ω	⅛ W	Prec	1%
R226	321-0143-00			301 Ω	⅛ W	Prec	1%
R230	308-0304-00			1.5 kΩ	3 W	WW	1%
R233	323-0239-00			3.01 kΩ	½ W	Prec	1%
R234	316-0220-00			22 Ω	¼ W		
R235	308-0291-00			2 kΩ	3 W	WW	5%
R239	315-0153-00	100	829	15 kΩ	¼ W		5%
R239	315-0123-00	830		12 kΩ	¼ W		5%
R240	321-0221-00	100	829	1.96 kΩ	⅛ W	Prec	1%
R240	321-0213-00	830		1.62 kΩ	⅛ W	Prec	1%
R242	311-0442-00			250 Ω, Var			
R244	311-0433-00			100 Ω, Var			
R245	321-0201-00			1.21 kΩ	⅛ W	Prec	1%
R246	323-0051-00			33.2 Ω	½ W	Prec	1%
R248	301-0470-00			47 Ω	½ W		5%
R249	303-0472-00			4.7 kΩ	1 W		5%
R250	315-0473-00			47 kΩ	¼ W		5%
R252	308-0077-00			1 kΩ	3 W	WW	
R254	*310-0631-00			1 kΩ	6 W	Prec	1%
R255	315-0270-00	100	829	27 Ω	¼ W		5%
R255	315-0390-00	830		39 Ω	¼ W		5%
R256	315-0470-00			47 Ω	¼ W		5%
R257	323-0341-00			34.8 kΩ	½ W	Prec	1%
R258	323-0350-00	100	829	43.2 kΩ	½ W	Prec	1%
R258	323-0348-00	830		41.2 kΩ	½ W	Prec	1%
R259	311-0326-00			10 kΩ, Var			

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R260	315-0221-00			220 Ω	¼ W		5%
R261	305-0152-00			1.5 kΩ	2 W		5%
R262	316-0220-00			22 Ω	¼ W		
R263	315-0820-00			82 Ω	¼ W		5%
R264	315-0820-00			82 Ω	¼ W		5%
R265	308-0329-00			4 kΩ	3 W	WW	2%
R267	323-0170-00			576 Ω	½ W	Prec	1%
R268	308-0406-00			1.2 kΩ	3 W	WW	1%
R269	315-0101-00			100 Ω	¼ W		5%
R270	324-0327-00			24.9 kΩ	1 W	Prec	1%
R271	323-0295-00			11.5 kΩ	½ W	Prec	1%
R272	307-0107-00			5.6 Ω	¼ W		5%
R273	302-0473-00			47 Ω	½ W		
R274	316-0100-00			10 kΩ	¼ W		
R275	305-0821-00			820 Ω	2 W		5%
R277	305-0391-00			390 Ω	2 W		5%
R278	315-0101-00			100 Ω	¼ W		5%
R279	303-0682-00			6.8 kΩ	1 W		5%
R280	308-0253-00			1.32 kΩ	3 W	WW	5%
R281	323-0291-00			10.5 kΩ	½ W	Prec	1%
R282	324-0327-00			24.9 kΩ	1 W	Prec	1%
R283	315-0120-00			12 Ω	¼ W		5%
R284	316-0100-00			10 Ω	¼ W		
R285	301-0473-00			47 kΩ	½ W		5%
R286	316-0100-00			10 Ω	¼ W		
R287	305-0821-00			820 Ω	2 W		5%
R289	303-0511-00			510 Ω	1 W		5%
R297	302-0100-00			10 Ω	½ W		
R400	315-0820-00			82 Ω	¼ W		5%
R401	315-0220-00			22 Ω	¼ W		5%
R402	316-0474-00	100	829	470 kΩ	¼ W		
R402	308-0301-00	830		10 kΩ	3 W	WW	1%
R404	305-0682-00			6.8 kΩ	2 W		5%
R407	315-0101-00	X830		100 Ω	¼ W		5%
R409	321-0129-00			215 Ω	⅛ W	Prec	1%
R413	315-0300-00			30 Ω	¼ W		5%
R414	323-0118-00			165 Ω	½ W	Prec	1%
R416	321-0122-00			182 Ω	⅛ W	Prec	1%
R422	321-0092-00			88.7 Ω	⅛ W	Prec	1%
R423	316-0101-00			100 Ω	¼ W		
R424	301-0123-00			12 kΩ	½ W		5%
R425	321-0114-00			150 Ω	⅛ W	Prec	1%
R426	321-0143-00			301 Ω	⅛ W	Prec	1%
R427	317-0511-00	X830		510 Ω	⅛ W		5%
R433	323-0239-00			3.01 kΩ	½ W	Prec	1%

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R434	316-0220-00			22 Ω	¼ W		
R440	308-0218-00			150 Ω	3 W	WW	5%
R441	308-0337-00			200 Ω	7 W	WW	5%
R442	308-0405-00			70 Ω	3 W	WW	5%
R443	305-0202-00			2 kΩ	2 W		5%
R446	323-0051-00			33.2 Ω	½ W	Prec	1%
R448	301-0470-00			47 Ω	½ W		5%
R449	303-0472-00			4.7 kΩ	1 W		5%
R450	315-0473-00			47 kΩ	¼ W		5%
R452	308-0077-00			1 kΩ	3 W	WW	
R454	*310-0631-00			1 kΩ	6 W	Prec	1%
R455	315-0270-00	100	829	27 Ω	¼ W		5%
R455	315-0390-00	830		39 Ω	¼ W		5%
R456	315-0470-00			47 Ω	¼ W		5%
R457	305-0822-00	100	829	8.2 kΩ	2 W		5%
R457	305-0432-00	830		4.3 kΩ	2 W		5%
R460	315-0221-00			220 Ω	¼ W		5%
R462	316-0220-00			22 Ω	¼ W		
R463	315-0820-00			82 Ω	¼ W		5%
R464	315-0820-00			82 Ω	¼ W		5%
R465	308-0329-00			4 kΩ	3 W	WW	2%
R467	323-0170-00			576 Ω	½ W	Prec	1%
R500	302-0101-00			100 Ω	½ W		
R501	315-0244-00			240 kΩ	¼ W		5%
R502	315-0244-00			240 kΩ	¼ W		5%
R504	321-1433-01			320 kΩ	⅛ W	Prec	½%
R505	322-1479-01			965 kΩ	¼ W	Prec	½%
R508	315-0244-00			240 kΩ	¼ W		5%
R510	315-0394-00			390 kΩ	¼ W		5%
R511	301-0625-00			6.2 MΩ	½ W		5%
R512	315-0105-00			1 MΩ	¼ W		5%
R514	301-0135-00			1.3 MΩ	½ W		5%
R516	315-0334-00			330 kΩ	¼ W		5%
R518[2]	311-0426-00			300 kΩ, Var			
R520	321-1433-01			320 kΩ	⅛ W	Prec	½%
R521	322-1479-01			965 kΩ	¼ W	Prec	½%
R526	322-0481-00			1 MΩ	¼ W	Prec	1%
R528	315-0104-00			100 kΩ	¼ W		5%
R531	315-0470-00			47 Ω	¼ W		5%
R533	316-0221-00			220 Ω	¼ W		
R536	315-0470-00			47 Ω	¼ W		5%
R538	316-0221-00			220 Ω	¼ W		
R541	308-0262-00			15 kΩ	5 W	WW	5%
R543	308-0206-00			7.5 kΩ	5 W	WW	5%

[2]Furnished as a unit with SW518.

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R544	301-0202-00	100	597	2 kΩ	½ W		5%
R544	315-0202-00	598		2 kΩ	¼ W		5%
R545	311-0442-00			250 kΩ, Var			
R547	316-0104-00			100 kΩ	¼ W		
R548	317-0220-00			22 Ω	⅛ W		5%
R549	308-0313-00			20 kΩ	3 W	WW	1%
R550	317-0220-00			22 Ω	⅛ W		5%
R552	315-0100-00			10 Ω	¼ W		5%
R553	321-0047-00			30.1 Ω	⅛ W	Prec	1%
R554	308-0320-00			15.6 kΩ	3 W	WW	1%
R555	323-0350-00			43.2 kΩ	½ W	Prec	1%
R556	311-0597-00			50 Ω, Var			
R557	323-0370-00			69.8 kΩ	½ W	Prec	1%
R558	323-0140-00			280 Ω	½ W	Prec	1%
R559	315-0560-00			56 Ω	¼ W		5%
R560	316-0224-00			220 kΩ	¼ W		
R561	323-0326-00			24.3 kΩ	½ W	Prec	1%
R562	307-0115-00			7.5 Ω	¼ W		5%
R563	321-0245-00			3.48 kΩ	⅛ W	Prec	1%
R564	316-0101-00			100 Ω	¼ W		
R565	301-0393-00			39 kΩ	½ W		5%
R566	316-0101-00			100 Ω	¼ W		
R567	315-0202-00			2 kΩ	¼ W		5%
R568	316-0101-00			100 Ω	¼ W		
R569	315-0103-00			10 kΩ	¼ W		5%
R570	316-0101-00			100 Ω	¼ W		
R571	316-0101-00			100 Ω	¼ W		
R572	301-0753-00	100	1999	75 kΩ	½ W		5%
R572	301-0623-00	2000		62 kΩ	½ W		5%
R574	301-0133-00			13 kΩ	½ W		5%
R575	316-0101-00			100 Ω	¼ W		
R576	301-0474-00			470 kΩ	½ W		5%
R577	301-0163-00			16 kΩ	½ W		5%
R578	316-0101-00	100	1999	100 Ω	¼ W		
R578	303-0243-00	2000		24 kΩ	1 W		5%
R579	302-0104-00	100	1999	100 kΩ	½ W		
R579	303-0513-00	2000		51 kΩ	1 W		5%
R580	315-0561-00			560 Ω	¼ W		5%
R581	*310-0577-00			14 kΩ	3 W	(tapped 7 kΩ) Prec	1%
R582	316-0470-00			47 Ω	¼ W		
R583	316-0101-00			100 Ω	¼ W		
R584	303-0243-00	100	1999	24 kΩ	1 W		5%
R584	315-0201-00	2000		200 Ω	¼ W		5%
R585	303-0513-00	100	1999	51 kΩ	1 W		5%
R585	315-0242-00	2000		2.4 kΩ	¼ W		5%

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R586	323-0318-00			20 kΩ	½ W	Prec	1%
R587	323-0419-00			226 kΩ	½ W	Prec	1%
R588	316-0470-00			47 Ω	¼ W		
R589	316-0101-00	100	1999	100 Ω	¼ W		
R589	308-0432-00	2000		30 kΩ	3 W	WW	1%
R590	316-0101-00	100	1999X	100 Ω	¼ W		
R591	316-0472-00	100	1999X	4.7 kΩ	¼ W		
R600	316-0470-00			47 Ω	¼ W		
R602	303-0513-00			51 kΩ	1 W		5%
R604	301-0303-00			30 kΩ	½ W		5%
R605	301-0912-00			9.1 kΩ	½ W		5%
R607	302-0103-00			10 kΩ	½ W		
R610	301-0393-00			39 kΩ	½ W		5%
R611	302-0471-00			470 Ω	½ W		
R613	301-0752-00			7.5 kΩ	½ W		5%
R614	302-0152-00			1.5 kΩ	½ W		
R616	301-0203-00			20 kΩ	½ W		5%
R617	301-0274-00			270 kΩ	½ W		5%
R618	315-0203-00			20 kΩ	¼ W		5%
R619	315-0120-00			12 Ω	¼ W		5%
R621	302-0221-00			220 Ω	½ W		
R622	316-0226-00			22 MΩ	¼ W		
R623	301-0183-00			18 kΩ	½ W		5%
R624	315-0394-00			390 kΩ	¼ W		5%
R625	324-0339-00			33.2 kΩ	1 W	Prec	1%
R627	308-0268-00			22 kΩ	5 W	WW	1%
R629	316-0101-00			100 Ω	¼ W		
R631	323-0368-00			66.5 kΩ	½ W	Prec	1%
R632	323-0399-00			140 kΩ	½ W	Prec	1%
R634	323-0275-00			7.15 kΩ	½ W	Prec	1%
R635	302-0562-00			5.6 kΩ	½ W		
R636	316-0101-00			100 Ω	¼ W		
R637	301-0754-00			750 kΩ	½ W		5%
R639	301-0226-00			22 MΩ	½ W		5%
R640	315-0202-00			2 kΩ	¼ W		5%
R641	303-0823-00			82 kΩ	1 W		5%
R643	316-0272-00			2.7 kΩ	¼ W		
R645	305-0243-00			24 kΩ	2 W		5%
R647	316-0153-00			15 kΩ	¼ W		
R648	316-0122-00			1.2 kΩ	¼ W		
R660A				7 MΩ	½ W		1%
R660B	*312-0641-00	100	599	2.8 MΩ	½ W		1%
R660C				1.4 MΩ	½ W		1%

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R660A	*312-0641-01	600		7 MΩ	½ W		1%
R660B				2.8 MΩ	½ W		1%
R660C				1.4 MΩ	½ W		1%
R660G				47 kΩ	(nominal value)	Selected	
R660D	*312-0640-00			700 kΩ	½ W		1%
R660E				280 kΩ	½ W		1%
R660F				140 kΩ	½ W		1%
R661	301-0392-00			3.9 kΩ	½ W		5%
R662[3]	311-0391-00			150 kΩ, Var			
R663	302-0105-00			1 MΩ	½ W		
R664	302-0104-00			100 kΩ	½ W		
R666	316-0101-00			100 Ω	¼ W		
R668	304-0473-00			47 kΩ	1 W		
R669	304-0473-00			47 kΩ	1 W		
R670	316-0101-00			100 Ω	¼ W		
R673	316-0101-00			100 Ω	¼ W		
R675	301-0155-00			1.5 MΩ	½ W		5%
R676	302-0102-00			1 kΩ	½ W		
R677	303-0183-00			18 kΩ	1 W		5%
R678	311-0011-00			5 kΩ, Var			
R679	305-0363-00			36 kΩ	2 W		5%
R680	323-0355-00	X2000		48.7 kΩ	½ W	Prec	1%
R681	323-0356-00			49.9 kΩ	½ W	Prec	1%
R682	323-0352-00			45.3 kΩ	½ W	Prec	1%
R683	311-0496-00	X2000		2.5 kΩ, Var			
R684	311-0510-00			10 kΩ, Var			
R685	321-0192-00			976 Ω	⅛ W	Prec	1%
R686	301-0272-00			2.7 kΩ	½ W		5%
R687	306-0683-00			68 kΩ	2 W		
R688	302-0104-00			100 kΩ	½ W		
R689	316-0101-00			100 Ω	¼ W		
R690	304-0273-00			27 k	1 W		
R692	302-0104-00			100 kΩ	½ W		
R696	302-0101-00			100 Ω	½ W		
R698	302-0101-00			100 Ω	½ W		
R699	316-0101-00			100 Ω	¼ W		
R700	302-0101-00			100 Ω	½ W		
R701	315-0244-00			240 kΩ	¼ W		5%
R702	315-0244-00			240 kΩ	¼ W		5%
R704	321-1433-01			320 kΩ	⅛ W	Prec	½%
R705	322-1479-01			965 kΩ	¼ W	Prec	½%
R708	315-0244-00			240 kΩ	¼ W		5%
R710	315-0394-00			390 kΩ	¼ W		5%
R711	301-0625-00			6.2 MΩ	½ W		5%

[3]Furnished as a unit with SW662.

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R712	315-0105-00			1 MΩ	1/4 W		5%
R714	301-0135-00			1.3 MΩ	1/2 W		5%
R716	315-0334-00			330 kΩ	1/4 W		5%
R718[4]	311-0426-00			300 kΩ, Var			
R720	321-1433-01			320 kΩ	1/8 W	Prec	1/2%
R721	322-1479-01			965 k	1/4 W	Prec	1/2%
R726	322-0481-00			1 MΩ	1/4 W	Prec	1%
R728	315-0104-00			100 kΩ	1/4 W		5%
R731	315-0470-00			47 Ω	1/4 W		5%
R733	316-0221-00			220 Ω	1/4 W		
R736	315-0470-00			47 Ω	1/4 W		5%
R738	316-0221-00			220 Ω	1/4 W		
R741	308-0262-00			15 kΩ	5 W	WW	5%
R743	308-0206-00			7.5 kΩ	5 W	WW	5%
R744	301-0202-00	100	597	2 kΩ	1/2 W		5%
R744	315-0202-00	598		2 kΩ	1/4 W		5%
R745	311-0442-00			250 Ω, Var			
R747	316-0104-00			100 kΩ	1/4 W		
R748	317-0220-00			22 Ω	1/8 W		5%
R749	308-0313-00			20 kΩ	3 W	WW	1%
R750	317-0220-00			22 Ω	1/8 W		5%
R752	315-0100-00			10 Ω	1/4 W		5%
R753	321-0047-00			30.1 Ω	1/8 W	Prec	1%
R754	308-0320-00			15.6 kΩ	3 W	WW	1%
R755	323-0350-00			43.2 kΩ	1/2 W	Prec	1%
R756	311-0597-00			50 Ω, Var			
R757	323-0370-00			69.8 kΩ	1/2 W	Prec	1%
R758	323-0140-00			280 Ω	1/2 W	Prec	1%
R759	315-0560-00			56 Ω	1/4 W		5%
R760	316-0224-00			220 kΩ	1/4 W		
R761	323-0326-00			24.3 kΩ	1/2 W	Prec	1%
R762	307-0115-00			7.5 Ω	1/4 W		5%
R763	321-0245-00			3.48 kΩ	1/8 W	Prec	1%
R764	316-0101-00			100 Ω	1/4 W		
R765	301-0393-00			39 kΩ	1/2W		5%
R766	316-0101-00			100 Ω	1/4 W		
R767	315-0202-00			2 kΩ	1/4 W		5%
R768	316-0101-00			100 Ω	1/4 W		
R769	315-0103-00			10 kΩ	1/4 W		5%
R770	316-0101-00			100 Ω	1/4 W		
R771	316-0101-00			100 Ω	1/4 W		
R772	301-0753-00	100	1999	75 kΩ	1/2 W		5%
R772	301-0623-00	2000		62 kΩ	1/2 W		5%
R774	301-0133-00			13 kΩ	1/2 W		5%

[4]Furnished as a unit with SW718.

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R775	316-0101-00			100 Ω	¼ W		
R776	301-0474-00			470 kΩ	½ W		5%
R777	301-0163-00			16 kΩ	½ W		5%
R778	302-0104-00	100	1999	100 kΩ	½ W		
R778	303-0243-00	2000		24 kΩ	1 W		5%
R779	302-0102-00	100	1999	1 kΩ	½ W		
R779	303-0513-00	2000		51 kΩ	1 W		5%
R780	315-0561-00			560 Ω	¼ W		5%
R781	*310-0577-00			14 kΩ	3 W	(tapped 7 kΩ) Prec	1%
R782	316-0470-00			47 Ω	¼ W		
R783	316-0101-00			100 Ω	¼ W		
R784	303-0243-00	100	1999	24 kΩ	1 W		5%
R784	315-0201-00	2000		200 Ω	¼ W		5%
R785	303-0513-00	100	1999	51 kΩ	1 W		5%
R785	315-0242-00	2000		2.4 kΩ	¼ W		5%
R786	323-0318-00			20 kΩ	½ W	Prec	1%
R787	323-0419-00			226 kΩ	½ W	Prec	1%
R788	316-0470-00			47 Ω	¼ W		
R789	316-0101-00	100	1999	100 Ω	¼ W		
R789A	301-0224-00	2000		220 kΩ	½ W		5%
R789B	308-0432-00	2000		30 kΩ	3 W	WW	1%
R790	316-0101-00	100	1999	100 Ω	¼ W		
R790	315-0152-00	2000		1.5 kΩ	¼ W		5%
R791	316-0472-00	100	1999	4.7 kΩ	¼ W		
R791	323-0362-00	2000		57.6 kΩ	½ W	Prec	1%
R792	301-0102-00	100	1999	1 kΩ	½ W		5%
R792	322-0289-00	2000		10 kΩ	¼ W	Prec	1%
R794	305-0103-00	100	1999	10 kΩ	2 W		5%
R794	323-0327-00	2000		24.9 kΩ	½ W	Prec	1%
R795	303-0203-00	100	1999	20 kΩ	1 W		5%
R795	307-0106-00	2000		4.7 Ω	¼ W		5%
R796[5]	311-0596-00	100	1999	10 kΩ, Var			
R796	301-0184-00	2000		180 kΩ	½ W		5%
R797	315-0302-00	100	1999	3 kΩ	¼ W		5%
R797	321-0318-00	2000		20 kΩ	⅛ W	Prec	1%
R798	301-0105-00	100	1999	1 MΩ	½ W		5%
R798	308-0313-00	2000		20 kΩ	3 W	WW	1%
R799	315-0114-00	100	1999	110 kΩ	¼ W		5%
R799	316-0101-00	2000		100 Ω	¼ W		
R800	316-0470-00			47 Ω	¼ W		
R802	303-0513-00			51 kΩ	1 W		5%
R804	301-0303-00			30 kΩ	½ W		5%
R805	301-0912-00			9.1 kΩ	½ W		5%

[5]Furnished as a unit with R1394.

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R807	302-0103-00			10 kΩ	½ W		
R810	301-0393-00			39 kΩ	½ W		5%
R811	302-0471-00			470 Ω	½ W		
R813	301-0752-00			7.5 kΩ	½ W		5%
R814	302-0152-00			1.5 kΩ	½ W		
R816	301-0203-00			20 kΩ	½ W		5%
R817	301-0274-00			270 kΩ	½ W		5%
R818	315-0203-00			20 kΩ	¼ W		5%
R819	315-0120-00			12 Ω	¼ W		5%
R821	302-0221-00			220 Ω	½ W		
R822	316-0226-00			22 MΩ	¼ W		
R823	301-0183-00			18 kΩ	½ W		5%
R824	315-0394-00			390 kΩ	¼ W		5%
R825	324-0339-00			33.2 kΩ	1 W	Prec	1%
R827	308-0268-00			22 kΩ	5 W	WW	1%
R829	316-0101-00			100 Ω	¼ W		
R831	323-0368-00			66.5 kΩ	½ W	Prec	1%
R832	323-0399-00			140 kΩ	½ W	Prec	1%
R833[8]	311-0596-00	X2000		10 kΩ, Var			
R834	323-0275-00			7.15 kΩ	½ W	Prec	1%
R835	302-0562-00			5.6 kΩ	½ W		
R836	316-0101-00			100 Ω	¼ W		
R837	301-0754-00			750 kΩ	½ W		5%
R839	301-0226-00			22 MΩ	½ W		5%
R840	315-0202-00			2 kΩ	¼ W		5%
R841	303-0823-00			82 kΩ	1 W		5%
R843	316-0272-00			2.7 kΩ	¼ W		
R845	305-0243-00			24 kΩ	2 W		5%
R847	316-0153-00			15 kΩ	¼ W		
R848	316-0122-00			1.2 kΩ	¼ W		
R850	315-0152-00	X2000		1.5 kΩ	¼ W		5%
R851	323-0362-00	X2000		57.6 kΩ	½ W	Prec	1%
R852	322-0289-00	X2000		10 kΩ	¼ W	Prec	1%
R853[7]	311-0596-00	X2000		10 kΩ, Var			
R854	323-0327-00	X2000		24.9 kΩ	½ W	Prec	1%
R855	307-0106-00	X2000		4.7 Ω	¼ W		5%
R856	301-0184-00	X2000		180 kΩ	½ W		5%
R857	321-0318-00	X2000		20 kΩ	⅛ W	Prec	1%
R858	308-0313-00	X2000		20 kΩ	3 W	WW	1%
R859	316-0101-00	X2000		100 Ω	¼ W		
R860A				7 MΩ	½ W		1%
R860B	*312-0641-00	100	599	2.8 MΩ	½ W		1%
R860C				1.4 MΩ	½ W		1%

[6]Furnished as a unit with R1344.

[7]Furnished as a unit with R1394.

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R860A	*312-0641-01	600		7 MΩ	½ W		1%
R860B				2.8 MΩ	½ W		1%
R860C				1.4 MΩ	½ W		1%
R860G				47 k	(nominal value) Selected		
R860D	*312-0640-00			700 kΩ	½ W		1%
R860E				280 kΩ	½ W		1%
R860F				140 kΩ	½ W		1%
R861	311-0600-00			7.5 kΩ, Var			
R862[8]	311-0391-00			150 kΩ, Var			
R863	302-0105-00			1 MΩ	½ W		
R864	302-0104-00			100 kΩ	½ W		
R866	316-0101-00			100 Ω	¼ W		
R868	304-0473-00			47 kΩ	1 W		
R869	304-0473-00			47 kΩ	1 W		
R870	316-0101-00			100 Ω	¼ W		
R873	316-0101-00			100 Ω	¼ W		
R875	301-0155-00			1.5 MΩ	½ W		5%
R876	302-0102-00			1 kΩ	½ W		
R877	303-0183-00			18 kΩ	1 W		5%
R878	311-0011-00			5 kΩ, Var			
R879	305-0363-00			36 kΩ	2 W		5%
R881	323-0356-00			49.9 kΩ	½ W	Prec	1%
R882	323-0356-00			49.9 kΩ	½ W	Prec	1%
R883	323-0352-00			45.3 kΩ	½ W	Prec	1%
R884	311-0510-00			10 kΩ, Var			
R885	321-0192-00			976 Ω	⅛ W	Prec	1%
R886	301-0272-00			2.7 kΩ	½ W		5%
R887	306-0683-00			68 kΩ	2 W		
R888	302-0104-00			100 kΩ	½ W		
R889	316-0101-00			100 Ω	¼ W		
R890	304-0273-00			27 kΩ	1 W		
R892	302-0104-00			100 kΩ	½ W		
R894	302-0101-00			100 Ω	½ W		
R896	302-0101-00			100 Ω	½ W		
R897	316-0101-00			100 Ω	¼ W		
R900	316-0101-00			100 Ω	¼ W		
R901	301-0102-00			1 kΩ	½ W		5%
R902	315-0471-00			470 Ω	¼ W		5%
R903	308-0321-00			24.4 kΩ	5 W	WW	1%
R904	301-0391-00			390 Ω	½ W		5%
R905	316-0101-00			100 Ω	¼ W		
R906	301-0102-00			1 kΩ	½ W		5%
R907	315-0471-00			470 Ω	¼ W		5%
R908	305-0303-00			30 kΩ	2 W		5%

[8]Furnished as a unit with SW862.

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R909	315-0471-00			470 Ω	¼ W		5%
R910	302-0101-00			100 Ω	½ W		
R911	316-0101-00			100 Ω	¼ W		
R912	302-0473-00			47 kΩ	½ W		
R913	324-0339-00			33.2 kΩ	1 W	Prec	1%
R914	311-0015-00			10 kΩ, Var			
R915	311-0022-00			30 kΩ, Var			
R916	302-0331-00			330 Ω	½ W		
R918	311-0141-00			2 kΩ, Var			
R919	308-0268-00			22 kΩ	5 W	WW	1%
R922	315-0224-00			220 kΩ	¼ W		5%
R924	315-0184-00			180 kΩ	¼ W		5%
R926	316-0121-00			120 Ω	¼ W		
R930	316-0682-00			6.8 kΩ	¼ W		
R933	316-0102-00			1 kΩ	¼ W		
R935	315-0470-00			47 Ω	¼ W		5%
R936	316-0102-00			1 kΩ	¼ W		
R938	316-0151-00			150 Ω	¼ W		
R939	315-0470-00			47 Ω	¼ W		5%
R1001	316-0103-00			10 kΩ	¼ W		
R1002	301-0474-00			470 kΩ	½ W		5%
R1008	301-0102-00			1 kΩ	½ W		5%
R1010	316-0103-00			10 kΩ	¼ W		
R1013	301-0274-00			270 kΩ	½ W		5%
R1014	301-0823-00			82 kΩ	½ W		5%
R1016	301-0154-00			150 kΩ	½ W		5%
R1018	315-0393-00			39 kΩ	¼ W		5%
R1019	301-0684-00			680 kΩ	½ W		5%
R1020	316-0103-00			10 kΩ	¼ W		
R1021	301-0123-00			12 kΩ	½ W		5%
R1023	301-0274-00			270 kΩ	½ W		5%
R1026	301-0683-00			68 kΩ	½ W		5%
R1028	315-0393-00			39 kΩ	¼ W		5%
R1029	301-0684-00			680 kΩ	½ W		5%
R1033	303-0513-00			51 kΩ	1 W		5%
R1034	315-0390-00	X2000		39 Ω	¼ W		5%
R1037	301-0104-00			100 kΩ	½ W		5%
R1040	316-0472-00			4.7 kΩ	¼ W		
R1041	316-0470-00			47 Ω	¼ W		
R1042	321-0258-00			4.75 kΩ	⅛ W	Prec	1%
R1043	323-0370-00			69.8 kΩ	½ W	Prec	1%
R1046	315-0105-00			1 MΩ	¼ W		5%
R1048	316-0105-00			1 MΩ	¼ W		
R1051	315-0474-00			470 kΩ	¼ W		5%
R1052	316-0101-00			100 Ω	¼ W		

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R1054	306-0332-00			3.3 kΩ	2 W		
R1060	316-0472-00			4.7 kΩ	¼ W		
R1061	316-0470-00			47 Ω	¼ W		
R1062	321-0258-00			4.75 kΩ	⅛ W	Prec	1%
R1063	323-0370-00			69.8 kΩ	½ W	Prec	1%
R1065	316-0185-00			1.8 MΩ	¼ W		
R1068	316-0105-00			1 MΩ	¼ W		
R1071	315-0474-00			470 kΩ	¼ W		5%
R1072	316-0101-00			100 Ω	¼ W		
R1074	306-0332-00			3.3 kΩ	2 W		
R1100B	323-0611-00			900 kΩ	½ W	Prec	1%
R1100D	323-0610-00			111 kΩ	½ W	Prec	1%
R1102	323-0481-00			1 MΩ	½ W	Prec	1%
R1103	316-0102-00			1 kΩ	¼ W		
R1105	315-0201-00			200 Ω	¼ W		5%
R1106	306-0333-00			33 kΩ	2 W		
R1107	306-0333-00			33 kΩ	2 W		
R1108	311-0599-00			10 kΩ, Var			
R1110	311-0026-00			100 kΩ, Var			
R1111	302-0224-00			220 kΩ	½ W		
R1112	316-0332-00			3.3 kΩ	¼ W		
R1113	316-0101-00			100 Ω	¼ W		
R1115	305-0183-00			18 kΩ	2 W		5%
R1116	323-0356-00			49.9 kΩ	½ W	Prec	1%
R1117	301-0475-00			4.7 MΩ	½ W		5%
R1118	302-0154-00			150 kΩ	½ W		
R1120	315-0390-00			39 Ω	¼ W		5%
R1125	301-0201-00			200 Ω	½ W		5%
R1130	316-0101-00			100 Ω	¼ W		
R1131	315-0394-00			390 kΩ	¼ W		5%
R1132	304-0123-00			12 kΩ	1 W		
R1134	315-0390-00			39 Ω	¼ W		5%
R1136A,B	311-0594-00			2x50 kΩ, Var			
R1137	323-0369-00			68.1 kΩ	½ W	Prec	1%
R1139	323-0446-00			432 kΩ	½ W	Prec	1%
R1141	302-0123-00			12 kΩ	½ W		
R1142	303-0753-00			75 kΩ	1 W		5%
R1144	304-0822-00	100	519	8.2 kΩ	1 W		
R1144	308-0286-00	520		8.2 kΩ	3 W	WW	5%
R1146	311-0172-00	100	1999	2.5 kΩ, Var			
R1146	311-0629-00	2000		3 kΩ, Var			
R1147	323-0284-00	100	1999	8.87 kΩ,	½ W	Prec	1%
R1147	323-0279-00	2000		7.87 kΩ	½ W	Prec	1%
R1149	305-0393-00			39 kΩ	2 W		5%
R1151	302-0104-00			100 kΩ	½ W		

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R1153	301-0303-00			30 kΩ	½ W		5%
R1154	308-0211-00			12 kΩ	5 W	WW	5%
R1155	323-0295-00			11.5 kΩ	½ W	Prec	1%
R1157	323-0252-00			4.12 kΩ	½ W	Prec	1%
R1158	302-0104-00			100 kΩ	½ W		
R1160	302-0104-00			100 kΩ	½ W		
R1162	308-0211-00			12 kΩ	5 W	WW	5%
R1163	323-0281-00			8.25 kΩ	½ W	Prec	1%
R1165	301-0122-00			1.2 kΩ	½ W		5%
R1166	323-0162-00			475 Ω	½ W	Prec	1%
R1167	311-0598-00			500 Ω, Var			
R1168	311-0026-00			100 kΩ, Var			
R1169	302-0473-00			47 kΩ	½ W		
R1170	316-0470-00			47 Ω	¼ W		
R1172	*310-0600-00			18 kΩ	8 W	(tapped 4.5 kΩ)	3%
R1173	316-0470-00			47 Ω	¼ W		
R1174	*310-0601-00			30 kΩ	8 W	Prec	1%
R1176	316-0470-00			47 Ω	¼ W		
R1178	308-0266-00			5 kΩ	5 W	WW	5%
R1179	303-0203-00			20 kΩ	1 W		5%
R1180	316-0470-00			47 Ω	¼ W		
R1182	*310-0611-00			18 kΩ	6 W	(tapped 3.7 kΩ and 13.5 kΩ)	1%
R1183	316-0470-00			47 Ω	¼ W		
R1184	*310-0601-00			30 kΩ	8 W	Prec	1%
R1186	316-0470-00			47 Ω	¼ W		
R1188	306-0224-00			220 kΩ	2 W		
R1190	302-0104-00			100 kΩ	½ W		
R1191	302-0563-00			56 kΩ	½ W		
R1192	302-0102-00			1 kΩ	½ W		
R1193	316-0470-00			47 Ω	¼ W		
R1195	302-0473-00			47 kΩ	½ W		
R1197	304-0103-00			10 kΩ	1 W		
R1200B	323-0611-00			900 kΩ	½ W	Prec	1%
R1200D	323-0610-00			111 kΩ	½ W	Prec	1%
R1202	323-0481-00			1 MΩ	½ W	Prec	1%
R1203	316-0102-00			1 kΩ	¼ W		
R1205	315-0201-00			200 Ω	¼ W		5%
R1206	306-0333-00			33 kΩ	2 W		
R1207	306-0333-00			33 kΩ	2 W		
R1208	311-0599-00			10 kΩ, Var			
R1210	311-0026-00			100 kΩ, Var			
R1211	302-0224-00			220 kΩ	½ W		
R1212	316-0332-00			3.3 kΩ	¼ W		
R1213	316-0101-00			100 Ω	¼ W		
R1215	305-0183-00			18 kΩ	2 W		5%

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R1216	323-0356-00			49.9 kΩ	½ W	Prec	1%
R1217	301-0475-00			4.7 MΩ	½ W		5%
R1218	302-0154-00			150 kΩ	½ W		
R1220	315-0390-00			39 Ω	¼ W		
R1225	301-0201-00			200 Ω	½ W		5%
R1230	316-0101-00			100 Ω	¼ W		
R1231	315-0394-00			390 kΩ	¼ W		5%
R1232	304-0123-00			12 kΩ	1 W		
R1234	315-0390-00			39 Ω	¼ W		5%
R1236A,B	311-0594-00			2x50 kΩ, Var			
R1237	323-0369-00			68.1 kΩ	½ W	Prec	1%
R1239	323-0446-00			432 kΩ	½ W	Prec	1%
R1241	302-0123-00			12 kΩ	½ W		
R1242	303-0753-00			75 kΩ	1 W		5%
R1244	304-0822-00	100	519	8.2 kΩ	1 W		
R1244	308-0286-00	520		8.2 kΩ	3 W	WW	5%
R1246	311-0172-00	100	1999	2.5 kΩ, Var			
R1246	311-0629-00	2000		3 kΩ, Var			
R1247	323-0284-00	100	1999	8.87 kΩ	½ W	Prec	1%
R1247	323-0279-00	2000		7.87 kΩ	½ W	Prec	1%
R1249	305-0393-00			39 kΩ	2 W		5%
R1251	302-0104-00			100 kΩ	½ W		
R1253	301-0303-00			30 kΩ	½ W		5%
R1254	308-0211-00			12 kΩ	5 W	WW	5%
R1255	323-0295-00			11.5 kΩ	½ W	Prec	1%
R1257	323-0252-00			4.12 kΩ	½ W	Prec	1%
R1258	302-0104-00			100 kΩ	½ W		
R1260	302-0104-00			100 kΩ	½ W		
R1262	308-0211-00			12 kΩ	5 W	WW	5%
R1263	323-0281-00			8.25 kΩ	½ W	Prec	1%
R1265	301-0122-00			1.2 kΩ	½ W		5%
R1266	323-0162-00			475 Ω	½ W	Prec	1%
R1267	311-0598-00			500 Ω, Var			
R1268	311-0026-00			100 kΩ, Var			
R1269	302-0473-00			47 kΩ	½ W		
R1270	316-0470-00			47 Ω	¼ W		
R1272	*310-0600-00			18 kΩ	8 W	(tapped 4.5 kΩ)	1%
R1273	316-0470-00			47 Ω	¼ W		
R1274	*310-0601-00			30 kΩ	8 W	Prec	1%
R1276	316-0470-00			47 Ω	¼ W		
R1278	308-0266-00			5 kΩ	5 W	WW	5%
R1279	303-0203-00			20 kΩ	1 W		5%
R1280	316-0470-00			47 Ω	¼ W		
R1282	*310-0611-00			18 kΩ	6 W	(tapped 3.7 kΩ and 13.5 kΩ)	1%
R1283	316-0470-00			47 Ω	¼ W		

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R1284	*310-0601-00			30 kΩ	8 W	Prec	1%
R1286	316-0470-00			47 Ω	¼ W		
R1288	306-0224-00			220 kΩ	2 W		
R1290	302-0104-00			100 kΩ	½ W		
R1291	302-0563-00			56 kΩ	½ W		
R1292	302-0102-00			1 kΩ	½ W		
R1293	316-0470-00			47 Ω	¼ W		
R1295	302-0473-00			47 kΩ	½ W		
R1297	304-0103-00			10 kΩ	1 W		
R1300	316-0102-00			1 kΩ	¼ W		
R1301	306-0101-00			100 Ω	2 W		
R1302	301-0333-00			33 kΩ	½ W		5%
R1303	308-0272-00	X2000		20 kΩ	5 W	WW	5%
R1305	306-0271-00			270 Ω	2 W		
R1307	301-0393-00			39 kΩ	½ W		5%
R1308	301-0153-00			15 kΩ	½ W		5%
R1310	315-0304-00			300 kΩ	¼ W		5%
R1311	301-0105-00			1 MΩ	½ W		5%
R1312	304-0154-00			150 kΩ	1 W		
R1314	302-0684-00			680 kΩ	½ W		
R1315	302-0333-00			33 kΩ	½ W		
R1316	302-0333-00			33 kΩ	½ W		
R1317	305-0755-00			7.5 MΩ	2 W		5%
R1318	305-0755-00			7.5 MΩ	2 W		5%
R1319	311-0415-00			1 MΩ, Var			
R1320	302-0335-00			3.3 MΩ	½ W		
R1321	301-0164-00			160 kΩ	½ W		5%
R1322	301-0205-00			2 MΩ	½ W		5%
R1323	317-0107-00			100 MΩ	⅛ W		5%
R1324	302-0333-00			33 kΩ	½ W		
R1325	316-0336-00			33 MΩ	¼ W		
R1326	316-0336-00			33 MΩ	¼ W		
R1327	316-0224-00			220 kΩ	¼ W		
R1328	316-0105-00			1 MΩ	¼ W		
R1329	316-0105-00			1 MΩ	¼ W		
R1330	302-0226-00			22 MΩ	½ W		
R1331	315-0104-00			100 kΩ	¼ W		5%
R1332	311-0034-00			500 kΩ, Var			
R1333	303-0155-00			1.5 MΩ	1 W		5%
R1334	303-0365-00			3.6 MΩ	1 W		5%
R1335	303-0365-00			3.6 MΩ	1 W		5%
R1336	311-0121-00			5 MΩ, Var			
R1337	303-0245-00			2.4 MΩ	1 W		5%
R1338	301-0474-00			470 Ω	½ W		5%
R1339	316-0681-00			680 Ω	¼ W		

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R1342	311-0026-00			100 kΩ, Var			
R1344	311-0023-00	100	1999	50 kΩ, Var			
R1344[9]	311-0596-00	2000		50 kΩ, Var			
R1346	301-0512-00			5.1 kΩ	½ W		5%
R1347	302-0471-00			470 Ω	½ W		
R1349	302-0105-00			1 MΩ	½ W		
R1351	306-0101-00			100 Ω	2 W		
R1352	301-0333-00			33 kΩ	½ W		5%
R1355	306-0271-00			270 Ω	2 W		
R1357	301-0393-00			39 kΩ	½ W		5%
R1358	301-0153-00			15 kΩ	½ W		5%
R1360	315-0304-00			300 kΩ	¼ W		5%
R1361	301-0105-00			1 MΩ	½ W		5%
R1362	304-0154-00			150 kΩ	1 W		
R1364	302-0684-00			680 kΩ	½ W		
R1365	302-0333-00			33 kΩ	½ W		
R1366	302-0333-00			33 kΩ	½ W		
R1367	305-0755-00			7.5 MΩ	2 W		5%
R1368	305-0755-00			7.5 MΩ	2 W		5%
R1369	311-0415-00			1 MΩ, Var			
R1370	302-0335-00			3.3 MΩ	½ W		
R1371	301-0164-00			160 kΩ	½ W		5%
R1372	301-0205-00			2 MΩ	½ W		5%
R1374	302-0333-00			33 kΩ	½ W		
R1376	316-0102-00			1 kΩ	¼ W		
R1379	308-0272-00	X2000		20 kΩ	5 W	WW	5%
R1382	311-0034-00			500 kΩ, Var			
R1383	303-0155-00			1.5 MΩ	1 W		5%
R1384	303-0365-00			3.6 MΩ	1 W		5%
R1385	303-0365-00			3.6 MΩ	1 W		5%
R1386	311-0121-00			5 MΩ, Var			
R1387	303-0245-00			2.4 MΩ	1 W		5%
R1388	301-0474-00			470 kΩ	½ W		5%
R1389	316-0681-00			680 Ω	¼ W		
R1390A,B[10]	311-0595-00			2x500 kΩ, Var			
R1391	311-0026-00			100 kΩ, Var			
R1392	323-0356-00			49.9 kΩ	½ W	Prec	1%
R1393	321-0373-00			75 kΩ	⅛ W	Prec	1%
R1394[11]	311-0596-00	100	1999	50 kΩ, Var			
R1394[12]	311-0596-00	2000		50 kΩ, Var			

[9]Furnished as a unit with R833.

[10]Furnished as a unit with R182.

[11]Furnished as a unit with R796.

[12]Furnished as a unit with R853.

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R1396	301-0512-00			5.1 kΩ	½ W		5%
R1397	302-0471-00			470 Ω	½ W		
R1399	302-0105-00			1 MΩ	½ W		
R1412	305-0183-00	100	1999	18 kΩ	2 W		5%
R1412	308-0302-00	2000		20 kΩ	5 W	WW	1%
R1413	316-0102-00	X2000		1 kΩ	¼ W		
R1414	305-0123-00	100	1999	12 kΩ	2 W		5%
R1414	308-0302-00	2000		20 kΩ	5 W	WW	1%
R1416	308-0302-00	100	1999	20 kΩ	5 W	WW	1%
R1416	301-0393-00	2000		39 kΩ	½ W		5%
R1418	308-0302-00	100	1999	20 kΩ	5 W	WW	1%
R1418	301-0224-00	2000		220 kΩ	½ W		5%
R1420	308-0310-00	100	1999	12 kΩ	5 W	WW	5%
R1420	315-0473-00	2000		47 kΩ	¼ W		5%
R1421	315-0330-00			33 Ω	¼ W		5%
R1422	308-0402-00	100	829	30 Ω	5 W	WW	5%
R1422	308-0446-00	830	1999X	15 Ω	5 W	WW	5%
R1424	306-0221-00	100	829	220 Ω	2 W		
R1424	306-0181-00	830	1999	180 Ω	2 W		
R1424	305-0243-00	2000		24 kΩ	2 W		5%
R1425	305-0391-00	X2000		390 Ω	2 W		5%
R1427	308-0183-00	100	829	500 Ω	10 W	WW	5%
R1427	308-0352-00	830		425 Ω	25 W	WW	1%
R1429	307-0023-00	100	1999	4.7 Ω	½ W		
R1429	308-0402-00	2000		30 Ω	5 W	WW	5%
R1430	306-0563-00	100	1999	56 kΩ	2 W		
R1430	303-0183-00	2000		18 kΩ	1 W		5%
R1431	301-0121-00	X2000		120 Ω	½ W		5%
R1432	303-0393-00	X2000		39 kΩ	1 W		5%
R1433	301-0363-00	100	1999	36 kΩ	½ W		5%
R1433	303-0273-00	2000		27 kΩ	1 W		5%
R1434	303-0473-00	100	1999X	47 kΩ	1 W		5%
R1435	316-0102-00			1 kΩ	¼ W		
R1436	308-0301-00			10 kΩ	3 W	WW	1%
R1437	308-0302-00			20 kΩ	5 W	WW	1%
R1438	316-0104-00			100 kΩ	¼ W		
R1439	311-0218-00			50 kΩ, Var			
R1440	306-0223-00	100	1999	22 kΩ	2 W		
R1440	305-0223-00	2000		22 kΩ	2 W		5%
R1442	308-0266-00	100	1999	5 kΩ	5 W	WW	5%
R1442	308-0402-00	2000		30 Ω	5 W	WW	5%
R1443	306-0221-00	100	1999	220 Ω	2 W		
R1443	308-0402-00	2000		30 Ω	5 W	WW	5%
R1444	308-0401-00	100	1999X	20 Ω	5 W	WW	5%
R1445	308-0404-00	100	1999	250 Ω	25 W	WW	5%

Resistors *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R1445	308-0447-00	2000		260 Ω	25 W	WW	1%
R1446	308-0404-00	100	1999	250 Ω	25 W	WW	5%
R1446	308-0447-00	2000		260 Ω	25 W	WW	1%
R1447	308-0401-00	100	1999X	20 Ω	5 W	WW	5%
R1448	316-0100-00			10 Ω	¼ W		
R1449	301-0101-00	X2000		100 Ω	½ W		5%
R1450	306-0333-00	100	1999	33 kΩ	2 W		
R1450	305-0273-00	2000		27 kΩ	2 W		5%
R1451	315-0121-00	X2000		120 Ω	¼ W		5%
R1452	303-0393-00	X2000		39 kΩ	1 W		5%
R1453	301-0303-00	100	1999	30 kΩ	½ W		5%
R1453	303-0243-00	2000		24 kΩ	1 W		5%
R1454	303-0473-00	100	1999X	47 kΩ	1 W		5%
R1455	308-0320-00			15.6 kΩ	3 W	WW	1%
R1456	315-0204-00			200 kΩ	¼ W		5%
R1457	316-0102-00	100	1999	1 kΩ	¼ W		
R1457	308-0359-00	2000		10.35 kΩ	3 W	WW	1%
R1458	308-0359-00	100	1999	10.35 kΩ	3 W	WW	1%
R1458	316-0102-00	2000		1 kΩ	¼ W		
R1459	311-0218-00			50 kΩ, Var			
R1461	308-0266-00	100	1999X	5 kΩ	5 W	WW	5%
R1462	316-0100-00			10 Ω	¼ W		
R1463	306-0223-00	100	1999	22 kΩ	2 W		
R1463	305-0163-00	2000		16 kΩ	2 W		5%
R1464	308-0246-00			20 Ω	10 W	WW	5%
R1465	301-0221-00	X2000		220 Ω	½ W		5%
R1467	308-0240-00	X2000		2 Ω	3 W	WW	5%
R1469	308-0246-00			20 Ω	10 W	WW	5%
R1472	306-0121-00	100	1999X	120 Ω	2 W		
R1474	308-0240-00	X2000		2 Ω	3 W	WW	5%
R1476	308-0404-00			250 Ω	25 W	WW	5%
R1477	308-0404-00			250 Ω	25 W	WW	5%
R1478	308-0404-00			250 Ω	25 W	WW	5%
R1484	301-0243-00			24 kΩ	½ W		5%
R1485	316-0562-00	100	1999	5.6 kΩ	¼ W		
R1485	315-0103-00	2000		10 kΩ	¼ W		5%
R1488	301-0103-00	100	1999	10 kΩ	½ W		5%
R1488	301-0153-00	2000		15 kΩ	½ W		5%
R1490	304-0103-00	100	1999	10 kΩ	1 W		
R1490	305-0822-00	2000		8.2 kΩ	2 W		5%
R1494	308-0301-00			10 kΩ	3 W	WW	1%
R1495	308-0403-00	X2000		8.5 kΩ	3 W	WW	1%
R1496	316-0104-00			100 kΩ	¼ W		
R1498	311-0218-00			50 kΩ, Var			
R1500	304-0223-00	100	1999	22 kΩ	1 W		

Resistors (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R1500	305-0133-00	2000		13 kΩ	2 W		5%
R1501	301-0103-00	100	1999	10 kΩ	½ W		5%
R1501	303-0622-00	2000		6.2 kΩ	1 W		5%
R1504	308-0266-00	100	1999X	5 kΩ	5 W	WW	5%
R1506	306-0333-00	100	1999	33 kΩ	2 W		
R1506	305-0223-00	2000		22 kΩ	2 W		5%
R1507	316-0100-00			10 Ω	¼ W		
R1513	308-0403-00	100	1999	8.5 kΩ	3 W	WW	1%
R1513	301-0101-00	2000		100 Ω	½ W		5%
R1514	308-0313-00	X2000		20 kΩ	3 W	WW	1%
R1517	308-0399-00	100	1999	10 Ω	5 W	WW	5%
R1517	308-0446-00	2000		15 Ω	5 W	WW	5%
R1519	308-0404-00			250 Ω	25 W	WW	5%
R1525	307-0103-00			2.7 Ω	¼ W		5%
R1527	316-0103-00			10 kΩ	¼ W		
R1528	316-0222-00			2.2 kΩ	¼ W		
R1529	307-0103-00			2.7 Ω	¼ W		5%
R1533	316-0104-00			100 kΩ	¼ W		
R1534	308-0269-00			22 Ω	3 W	WW	5%
R1535	307-0103-00			2.7 Ω	¼ W		5%
R1536	311-0377-00			25 Ω, Var			
R1537	316-0103-00			10 kΩ	¼ W		
R1538	316-0222-00			2.2 kΩ	¼ W		
R1539	307-0103-00			2.7 Ω	¼ W		5%
R1550	302-0185-00			1.8 MΩ	½ W		
R1552	323-0097-00			100 Ω	½ W	Prec	1%
R1555	324-0097-00			100 Ω	1 W	Prec	1%
R1558	323-0097-00			100 Ω	½ W	Prec	1%
R1562	323-0097-00			100 Ω	½ W	Prec	1%
R1565	307-0103-00			2.7 Ω	¼ W		5%
R1582	323-0097-00			100 Ω	½ W	Prec	1%
R1585	324-0097-00			100 Ω	1 W	Prec	1%
R1588	323-0097-00			100 Ω	½ W	Prec	1%
R1592	323-0097-00			100 Ω	½ W	Prec	1%
R1595	307-0103-00			2.7 Ω	¼ W		5%
R1601	302-0221-00			220 Ω	½ W		
R1602	305-0332-00			3.3 kΩ	2 W		5%
R1604	302-0101-00			100 Ω	½ W		
R1605	308-0310-00			12 kΩ	5 W	WW	1%
R1607	316-0104-00			100 kΩ	¼ W		
R1608	301-0914-00			910 kΩ	½ W		5%
R1615	308-0400-00			18 kΩ	5 W	WW	5%
R1616	302-0470-00			47 Ω	½ W		
R1617	316-0102-00			1 kΩ	¼ W		
R1618	301-0914-00			910 kΩ	½ W		5%

Resistors (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
R1620	302-0103-00			10 kΩ	½ W		
R1622	302-0470-00			47 Ω	½ W		
R1624	316-0220-00			22 Ω	¼ W		
R1626	304-0104-00			100 kΩ	1 W		
R1628	311-0365-00			1 kΩ, Var			
R1630	323-0636-00			50 kΩ	½ W	Prec	1%
R1632	323-0709-01			10.048 kΩ	½ W	Prec	½%
R1633	323-0708-01			6.628 kΩ	½ W	Prec	½%
R1634	323-0707-01			1.782 kΩ	½ W	Prec	½%
R1635	323-0706-01			800 Ω	½ W	Prec	½%
R1636	323-0705-01			452 Ω	½ W	Prec	½%
R1637	323-0704-01			146 Ω	½ W	Prec	½%
R1638	323-0703-01			72.4 Ω	½ W	Prec	½%
R1639	323-0702-01			43.1 Ω	½ W	Prec	½%
R1640	323-0701-01			28.6 Ω	½ W	Prec	½%
R1645	323-0700-01			21.4 Ω	½ W	Prec	½%
R1647	323-0638-00			50 kΩ	½ W	Prec	¼%
R1650	323-0637-00			50 Ω	½ W	Prec	¼%
R1654	*308-0090-00			0.25 Ω	1 W	WW	

Switches

Ckt. No.	Unwired or Wired	Eff	Disc	Description	
SW105	260-0601-00			Push-Button	Compensation
SW155	260-0763-00			Push-Button	BEAM LOCATE
SW185	Wired *262-0768-00	100	1999	Rotary	UPPER BEAM DISPLAY
SW185	260-0752-00	100	1999	Rotary	UPPER BEAM DISPLAY
SW185	Wired *262-0768-01	2000		Rotary	UPPER BEAM DISPLAY
SW185	260-0752-01	2000		Rotary	UPPER BEAM DISPLAY
SW205	260-0601-00			Push-Button	Compensation
SW500	Wired *262-0774-00 (A Sweep)			Lever	SOURCE
SW505				Lever	MODE
SW510				Lever	COUPLING
SW515				Lever	SOURCE
SW520				Lever	SLOPE
SW500	260-0753-00			Lever	SOURCE
SW505	260-0750-00			Lever	MODE
SW510	260-0754-00			Lever	COUPLING
SW515	260-0749-00			Lever	SOURCE
SW518[13]				Push-Pull	Pull for ×10 Range Increase
SW520	260-0472-00			Lever	SLOPE
SW547	260-0552-00			Reed	
SW620	260-0574-01			Push-Pull	RESET

[13]Furnished as a unit with R518.

Switches *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc		Description
SW625	260-0640-00			Lever	A MODE
SW660	Wired *262-0766-00			Rotary	A TIME/CM
SW660	260-0756-00			Rotary	A TIME/CM
SW662[14]					
SW700	Wired *262-0775-00 (B Sweep)			Lever	SOURCE
SW705				Lever	MODE
SW710				Lever	COUPLING
SW715				Lever	SOURCE
SW720				Lever	SLOPE
SW700	260-0753-00			Lever	SOURCE
SW705	260-0750-00			Lever	MODE
SW710	260-0754-00			Lever	COUPLING
SW715	260-0749-00			Lever	SOURCE
SW718[15]				Push-Pull	Pull for ×10 Range Increase
SW720	260-0472-00			Lever	SLOPE
SW747	260-0552-00			Reed	
SW775	Wired *262-0769-00	100	1999	Rotary	LOWER BEAM DISPLAY
SW775	260-0751-00	100	1999	Rotary	LOWER BEAM DISPLAY
SW775	Wired *262-0769-01	2000		Rotary	LOWER BEAM DISPLAY
SW775	260-0751-01	2000		Rotary	LOWER BEAM DISPLAY
SW820	260-0574-01			Push-Button	RESET
SW825	260-0748-00			Lever	B MODE
SW860	Wired *262-0767-00			Rotary	B TIME/CM
SW860	260-0756-00			Rotary	B TIME/CM
SW862[16]					
SW1120	Wired *262-0796-00	X520		Lever	DISPLAY MAG (upper beam)
SW1120	260-0755-00			Lever	DISPLAY MAG (upper beam)
SW1125	260-0552-00			Reed	
SW1220	Wired *262-0796-01	X520		Lever	DISPLAY MAG (lower beam)
SW1220	260-0755-00			Lever	DISPLAY MAG (lower beam)
SW1225	260-0552-00			Reed	
SW1345	260-0784-00			Toggle	CRT Cath Selector (lower beam)
SW1395	260-0784-00			Toggle	CRT Cath Selector (upper beam)
SW1402	260-0785-00			Toggle	POWER
SW1403[17]					
SW1404[17]					
SW1630	Wired *262-0731-00			Rotary	AMPLITUDE CALIBRATOR
SW1630	260-0536-00			Rotary	AMPLITUDE CALIBRATOR

[14]Furnished as a unit with R662.

[15]Furnished as a unit with R718.

[16]Furnished as a unit with R862.

[17]See Mechanical Parts List. Line Voltage Selector Body.

Thermal Cut-Out

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description	
TK404	260-0618-00			140° F	±5°

Transformers

Ckt. No.	Tektronix Part No.	Eff	Disc	Description
T555	*120-0437-00			Toroid, 2 windings
T755	*120-0437-00			Toroid, 2 windings
T905	*120-0434-00			Toroid, 5 turns, bifilar
T1301	*120-0432-00			H.V. Power (lower beam)
T1351	*120-0433-00			H.V. Power (upper beam)
T1401	*120-0431-00	100	1999	L.V. Power
T1401	*120-0431-01	2000		L.V. Power
T1525	*120-0440-00			Toroid, 6 turns, bifilar
T1535	*120-0440-00			Toroid, 6 turns, bifilar

Electron Tubes

Ckt. No.	Tektronix Part No.	Eff	Disc	Description
V3	*157-0118-00			12AT7 aged
V64	154-0491-00			8608
V164	154-0491-00			8608
V203	*157-0118-00			12AT7 aged
V254	154-0491-00			8608
V454	154-0491-00			8608
V534	154-0187-00			6DJ8
V574	154-0493-00			6M11
V583	154-0187-00			6DJ8
V625	154-0187-00			6DJ8
V661	154-0040-00			12AU6
V673	154-0187-00			6DJ8
V734	154-0187-00			6DJ8
V774	154-0493-00			6M11
V783	154-0187-00			6DJ8
V825	154-0187-00			6DJ8
V861	154-0040-00			12AU6
V873	154-0187-00			6DJ8
V904	154-0187-00			6DJ8
V1043	154-0187-00			6DJ8
V1063	154-0187-00			6DJ8
V1104	154-0187-00			6DJ8
V1174	154-0187-00			6DJ8
V1184	154-0187-00			6DJ8
V1194	154-0146-00			6197
V1204	154-0187-00			6DJ8
V1274	154-0187-00			6DJ8
V1284	154-0187-00			6DJ8

Electron Tubes *(cont)*

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
V1294	154-0146-00			6197
V1300	154-0494-00			6GF5
V1322	154-0051-00			5642
V1332	154-0051-00			5642
V1342	154-0051-00			5642
V1350	154-0494-00			6GF5
V1359	*154-0500-00			T5560-31-1 CRT Standard Phosphor
V1482	154-0370-00			ZZ1000
V1605	154-0493-00			6M11

INDEX OF MECHANICAL PARTS LIST ILLUSTRATIONS

(Located behind diagrams)

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations which appear on the pullout pages immediately following the Diagrams section of this instruction manual.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the Description column.

Assembly and/or Component
  Detail Part of Assembly and/or Component
  mounting hardware for Detail Part
    Parts of Detail Part
    mounting hardware for Parts of Detail Part
mounting hardware for Assembly and/or Component

Mounting hardware always appears in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation.

Mounting hardware must be purchased separately, unless otherwise specified.

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial or model number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

ABBREVIATIONS AND SYMBOLS

For an explanation of the abbreviations and symbols used in this section, please refer to the page immediately preceding the Electrical Parts List in this instruction manual.

SECTION 8

MECHANICAL PARTS LIST

FIG. 1 FRONT & SWITCHES

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
1-1	333-0922-01	100	2009	1	PANEL, front
	333-0922-05	2010		1	PANEL, front
	- - - - - -			-	mounting hardware: (not included w/panel)
-2	213-0055-00			4	SCREW, thread forming, 2-56 x $^3/_{16}$ inch, PHS
-3	213-0113-00			2	SCREW, thread forming, 2-32 x $^5/_{16}$ inch, RHS
-4	354-0262-00			1	RING, light reflector, plate
-5	386-0212-00			1	PLATE, light reflector
-6	- - - - - -			-	FILTER, light, smokey grey (see fig. 9)
-7	378-0572-00			1	FILTER, mesh
	- - - - - -			-	filter includes:
-8	426-0273-00			1	FRAME, rear mesh filter
	- - - - - -			-	mounting hardware: (not included w/filter)
-9	210-0424-00			4	NUT, knurled, $^3/_8$-24 x $^9/_{16}$ inch
-10	386-1008-00			1	PLATE, sub-panel, front
	- - - - - -			-	plate includes:
	354-0282-00			1	RING, ornamental
-11	355-0043-00			4	STUD, graticule (replacement)
	- - - - - -			-	each stud includes:
	212-0507-00			1	SCREW, 10-32 x $^3/_8$ inch, PHS
	210-0010-00			1	LOCKWASHER, internal, #10
-12	131-0106-01			9	CONNECTOR, coaxial, 1 contact, BNC
-13	131-0274-00			1	CONNECTOR, insulated, 1 contact, BNC
-14	337-0850-00			1	GUARD, shielding, gasket, B inside
	- - - - - -			-	mounting hardware: (not included w/guard)
-15	211-0559-00			4	SCREW, 6-32 x $^3/_8$ inch, 100° csk, FHS
-16	352-0084-00			6	HOLDER, neon
-17	378-0541-00			2	LENS, neon, clear
-18	378-0541-01			4	LENS, neon, green
-19	200-0609-00			6	COVER, neon holder
-20	214-0335-00			1	BOLT, current loop, U shaped
	- - - - - -			-	mounting hardware: (not included w/bolt)
-21	210-0593-00			2	NUT, hex., 3-48 x $^1/_4$ inch, current loop
-22	361-0059-00			1	SPACER, current loop
	210-0849-00			2	WASHER, fiber, 0.110 ID x 0.250 inch OD
	210-0801-00			2	WASHER, flat, 0.140 ID x 0.281 inch OD
	210-0201-00			2	LUG, solder, #4
	210-0442-00			2	NUT, hex., 3-48 x $^3/_{16}$ inch
-23	136-0027-00			1	SOCKET, light, w/green jewel

FIG. 1 FRONT & SWITCHES *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
1-24	260-0574-01			2	SWITCH, push button—RESET
	- - - - - -			-	mounting hardware for each: (not included w/switch)
	354-0055-00			1	RING, switch locking, $^{15}/_{32}$ ID x $^{23}/_{32}$ inch OD
	210-0902-00			1	WASHER, flat, 0.470 ID x $^{21}/_{32}$ inch OD
	210-0473-00			1	NUT, 12 sided, $^{15}/_{32}$-32 x $^{5}/_{64}$ inch
-25	260-0785-00			1	SWITCH, toggle—POWER
	- - - - - -			-	mounting hardware: (not included w/switch)
	354-0055-00			1	RING, switch locking, $^{15}/_{32}$ ID x $^{23}/_{32}$ inch OD
	210-0902-00			1	WASHER, flat, 0.470 ID x $^{21}/_{32}$ inch OD
	210-0473-00			1	NUT, 12 sided, $^{15}/_{32}$-32 x $^{5}/_{64}$ inch
-26	366-0215-01			1	KNOB, charcoal—SOURCE A
-27	366-0215-01			1	KNOB, charcoal—SOURCE A
-28	366-0215-01			1	KNOB, charcoal—COUPLING A
-29	366-0215-01			1	KNOB, charcoal—SLOPE A
-30	366-0215-01			1	KNOB, charcoal—MODE A
-31	262-0774-00			1	SWITCH, wired—TRIGGER BANK A
	- - - - - -			-	switch includes:
-32	260-0749-00			1	SWITCH, unwired—SOURCE A
-33	260-0753-00			1	SWITCH, unwired—SOURCE A
-34	260-0754-00			1	SWITCH, unwired—COUPLING
-35	260-0472-00			1	SWITCH, unwired—SLOPE A
-36	260-0750-00			1	SWITCH, unwired—MODE A
	- - - - - -			-	mounting hardware for each: (not included w/switch)
-37	213-0141-00			10	SCREW, thread forming, 4-40 x $^{1}/_{4}$ inch, PHS
-38	407-0211-01			2	BRACKET, switch mounting
-39	670-0433-00			1	ASSEMBLY, circuit board
	- - - - - -			-	assembly includes:
	388-0690-00			1	BOARD, circuit
	- - - - - -			-	board includes:
-40	131-0214-00			25	CONNECTOR, square pin, male
	- - - - - -			-	mounting hardware: (not included w/switch)
-41	210-0586-00			4	NUT, keps, 4-40 x $^{1}/_{4}$ inch
-42	366-0215-01			1	KNOB, charcoal—MODE B
-43	366-0215-01			1	KNOB, charcoal—SLOPE B
-44	366-0215-01			1	KNOB, charcoal—COUPLING B
-45	366-0215-01			1	KNOB, charcoal—SOURCE B
-46	366-0215-01			1	KNOB, charcoal—SOURCE B
-47	262-0775-00			1	SWITCH, wired—TRIGGER BANK B
	- - - - - -			-	switch includes:
-48	260-0750-00			1	SWITCH, unwired—MODE B
-49	260-0472-00			1	SWITCH, unwired—SLOPE B
-50	260-0754-00			1	SWITCH, unwired—COUPLING B
-51	260-0753-00			1	SWITCH, unwired—SOURCE B
-52	260-0749-00			1	SWITCH, unwired—SOURCE B
	- - - - - -			-	mounting hardware for each: (not included w/switch)
-53	213-0141-00			10	SCREW, thread forming, 4-40 x $^{1}/_{4}$ inch, PHS
-54	407-0211-02			2	BRACKET, switch mounting

FIG. 1 FRONT & SWITCHES *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
1-55	670-0434-00			1	ASSEMBLY, circuit board
	- - - - - -			-	assembly includes:
	388-0689-00			1	BOARD, circuit
	- - - - - -			-	board includes:
-56	131-0214-00			25	CONNECTOR, square pin
	- - - - - -			-	mounting hardware: (not included w/switch)
-57	210-0586-00			4	NUT, keps, 4-40 x 1/4 inch
-58	366-0215-01			1	KNOB, charcoal—B MODE
-59	260-0748-00			1	SWITCH, unwired—B MODE
	- - - - - -			-	mounting hardware: (not included w/switch)
	210-0586-00			2	NUT, keps, 4-40 x 1/4 inch
-60	366-0215-01			1	KNOB, charcoal—DISPLAY MAG B
-61	260-0755-00	100	519	1	SWITCH, unwired—DISPLAY MAG B
	262-0796-01	520		1	SWITCH, wired—DISPLAY MAG B
	- - - - - -			-	switch includes:
	260-0755-00	520		1	SWITCH, unwired
	- - - - - -			-	mounting hardware: (not included w/switch)
-62	220-0413-00			2	NUT, hex., 4-40 x 3/16 x 0.562 inch long
-63	366-0215-01			1	KNOB, charcoal—A MODE
-64	260-0640-00			1	SWITCH, unwired—A MODE
	- - - - - -			-	mounting hardware: (not included w/switch)
	210-0586-00			2	NUT, keps, 4-40 x 1/4 inch
-65	366-0215-01			1	KNOB, charcoal—DISPLAY MAG A
-66	260-0755-00	100	519	1	SWITCH, unwired—DISPLAY MAG A
	262-0796-00	520		1	SWITCH, wired—DISPLAY MAG A
	- - - - - -			-	switch includes:
	260-0755-00	520		1	SWITCH, unwired
	- - - - - -			-	mounting hardware: (not included w/switch)
	220-0413-00			2	NUT, hex., 4-40 x 3/16 x 0.562 inch long
-67	366-0220-00			1	KNOB, charcoal—INTENSITY B
	- - - - - -			-	knob includes:
	213-0020-00			1	SCREW, set, 6-32 x 1/8 inch, HSS
-68	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0013-00			1	LOCKWASHER, internal, 3/8 ID x 11/16 inch OD
	210-0978-00			1	WASHER, flat, 3/8 ID x 1/2 inch OD
	210-0590-00			1	NUT, hex., 3/8-32 x 7/16 inch
-69	200-0269-00			4	COVER, variable resistor, plastic
-70	366-0220-00			1	KNOB, charcoal—FOCUS
	- - - - - -			-	knob includes:
	213-0020-00			1	SCREW, set, 6-32 x 1/8 inch, HSS
-71	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0013-00			1	LOCKWASHER, internal, 3/8 ID x 11/16 inch OD
	210-0978-00			1	WASHER, flat, 3/8 ID x 1/2 inch OD
	210-0590-00			1	NUT, hex., 3/8-32 x 7/16 inch

FIG. 1 FRONT & SWITCHES *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
1-72	366-0220-00	100	2009	1	KNOB, charcoal—ASTIGMATISM
	366-0360-00	2010		1	KNOB, charcoal—ASTIGMATISM
	- - - - - -			-	knob includes:
	213-0020-00			1	SCREW, set, 6-32 x 1/8 inch, HSS
-73	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0012-00			1	LOCKWASHER, internal, 3/8 ID x 1/2 inch OD
	210-0978-00			1	WASHER, flat, 3/8 ID x 1/2 inch OD
	210-0590-00			1	NUT, hex., 3/8-32 x 7/16 inch
-74	366-0117-00			1	KNOB, charcoal—AMPLITUDE CALIBRATOR
	- - - - - -			-	knob includes:
	213-0020-00			1	SCREW, set, 6-32 x 1/8 inch, HSS
-75	262-0731-00			1	SWITCH, wired—AMPLITUDE CALIBRATOR
	- - - - - -			-	switch includes:
	260-0536-00			1	SWITCH, unwired—AMPLITUDE CALIBRATOR
	- - - - - -			-	mounting hardware: (not included w/switch)
	210-0013-00			1	LOCKWASHER, internal, 3/8 ID x 11/16 inch OD
	210-0590-00			1	NUT, hex., 3/8-32 x 7/16 inch
-76	366-0361-00			1	KNOB, charcoal—BEAM LOCATE
-77	260-0763-00			1	SWITCH, unwired—BEAM LOCATE
	- - - - - -			-	mounting hardware: (not included w/switch)
	210-0413-00			1	NUT, hex., 3/8-32 x 3/8 inch
-78	220-0448-00			1	NUT, hex., spacing, 3/8-32 x 1/2 x 2 3/4 inches long
	210-0012-00			1	LOCKWASHER, internal, 3/8 ID x 1/2 inch OD
-79	358-0299-00			1	BUSHING, 3/8-32 x 0.397 inch long
-80	331-0091-00			1	DIAL, duo dial, w/o brake
-81	366-0220-00			1	KNOB, charcoal—UPPER BEAM EXT HORIZ VAR 1-10
	- - - - - -			-	knob includes:
	213-0020-00			1	SCREW, set, 6-32 x 1/8 inch, HSS
-82	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0013-00			1	LOCKWASHER, internal, 3/8 ID x 11/16 inch OD
	210-0978-00			1	WASHER, flat, 3/8 ID x 1/2 inch OD
	210-0590-00			1	NUT, hex., 3/8-32 x 7/16 inch
-83	366-0254-00			1	KNOB, charcoal—TRACE ROTATION TRACE SEPARATION
	- - - - - -			-	knob includes:
	213-0020-00			1	SCREW, set, 6-32 x 1/8 inch, HSS
-84	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0207-00			1	LUG, solder, 3/8 ID x 5/8 inch OD, SE
	210-0012-00			1	LOCKWASHER, internal, 3/8 ID x 1/2 inch OD
	210-0978-00			1	WASHER, flat, 3/8 ID x 1/2 inch OD
	210-0590-00			1	NUT, hex., 3/8-32 x 7/16 inch
-85	366-0220-00			1	KNOB, charcoal—SCALE ILLUM
	- - - - - -			-	knob includes:
	213-0020-00			1	SCREW, set, 6-32 x 1/8 inch, HSS

FIG. 1 FRONT & SWITCHES *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
1-86	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0012-00			1	LOCKWASHER, internal, 3/8 ID x 1/2 inch OD
	210-0978-00			1	WASHER, flat, 3/8 ID x 1/2 inch OD
	210-0590-00			1	NUT, hex., 3/8-32 x 7/16 inch
-87	366-0220-00			1	KNOB, charcoal—LOWER BEAM EXT HORIZ VAR 1-10
	- - - - - -			-	knob includes:
	213-0020-00			1	SCREW, set, 6-32 x 1/8 inch, HSS
-88	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0012-00			1	LOCKWASHER, internal, 3/8 ID x 1/2 inch OD
	210-0978-00			1	WASHER, flat, 3/8 ID x 1/2 inch OD
	210-0590-00			1	NUT, hex., 3/8-32 x 7/16 inch
-89	366-0160-00			1	KNOB, charcoal—LOWER BEAM DISPLAY
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
-90	366-0081-00			1	KNOB, red—POSITION B
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
-91	262-0769-00	100	2009	1	SWITCH, wired—LOWER BEAM DISPLAY
	262-0769-01	2010		1	SWITCH, wired—LOWER BEAM DISPLAY
	- - - - - -			-	switch includes:
	260-0751-00	100	2009	1	SWITCH, unwired
	260-0751-01	2010		1	SWITCH, unwired
-92	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
-93	210-0012-00			1	LOCKWASHER, internal, 3/8 ID x 1/2 inch OD
-94	210-0413-00			2	NUT, hex., 3/8-32 x 1/2 inch
-95	376-0014-00			1	COUPLING, wire, steel
-96	384-0391-00			1	ROD, extension, shaft
	- - - - - -			-	mounting hardware: (not included w/switch)
	211-0008-00			2	SCREW, 4-40 x 1/4 inch, PHS
	210-0013-00			1	LOCKWASHER, internal, 3/8 ID x 11/16 inch OD
	210-0590-00			1	NUT, hex., 3/8-32 x 7/16 inch
-97	366-0144-00			1	KNOB, charcoal—B TIME/CM
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
-98	366-0038-00			1	KNOB, red—VARIABLE B
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
-99	262-0767-00			1	SWITCH, wired—B TIME/CM
	- - - - - -			-	switch includes:
	260-0756-00			1	SWITCH, unwired—B TIME/CM
-100	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
-101	210-0413-00			2	NUT, hex., 3/8-32 x 1/2 inch
-102	210-0255-00			1	LUG, solder, 3/8 ID x 0.500 inch OD, SE

FIG. 1 FRONT & SWITCHES *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
1-103	------			1	RESISTOR, variable
	------			-	resistor includes:
	210-0438-00			2	NUT, hex., 1-72 x $^5/_{32}$ inch
	------			-	mounting hardware: (not included w/resistor)
-104	406-0635-00			1	BRACKET, variable resistor mounting
-105	213-0088-00			2	SCREW, thread forming, #4 x $^1/_4$ inch, PHS
-106	407-0214-00			1	BRACKET, switch mounting
	------			-	mounting hardware: (not included w/bracket)
	210-0006-00			2	LOCKWASHER, internal #6
	210-0449-00			2	NUT, hex., 5-40 x $^1/_4$ inch
-107	------			1	CAPACITOR
	------			-	mounting hardware: (not included w/capacitor)
-108	210-0457-00			2	NUT, keps, 6-32 x $^5/_{16}$ inch
	210-0407-00			2	NUT, hex., 6-32 x $^1/_4$ inch
-109	348-0055-00			1	GROMMET, plastic, $^1/_4$ inch diameter
-110	131-0183-00			2	CONNECTOR, terminal feed thru
	------			-	mounting hardware for each: (not included w/connector)
	358-0136-00			1	BUSHING, plastic, connector
-111	------			1	CAPACITOR
	------			-	mounting hardware: (not included w/capacitor)
	210-0018-00			1	LOCKWASHER, internal, $^3/_{16}$ inch
-112	210-0524-00			1	NUT, hex., $^5/_{16}$-24 x $^1/_2$ inch
	179-1073-00			1	CABLE HARNESS, time/cm switch
-113	384-0389-00			1	ROD, external shaft, 0.125 x 8 inches long
-114	376-0014-00			1	COUPLING, wire steel
	------			-	mounting hardware: (not included w/switch)
	210-0012-00			1	LOCKWASHER, internal, $^3/_8$ ID x $^1/_2$ inch OD
	210-0590-00			1	NUT, hex., $^3/_8$-32 x $^7/_{16}$ inch
	211-0507-00			2	SCREW, 6-32 x $^5/_{16}$ inch, PHS
-115	366-0173-00			1	KNOB, charcoal—LEVEL B
	------			-	knob includes:
	213-0004-00			1	SCREW, 6-32 x $^3/_{16}$ inch, HSS
-116	------			1	RESISTOR, variable
	------			-	mounting hardware: (not included w/resistor)
	210-0978-00			1	WASHER, flat, $^3/_8$ ID x $^1/_2$ inch OD
	210-0590-00			1	NUT, hex., $^3/_8$-32 x $^7/_{16}$ inch
-117	366-0144-00			1	KNOB, charcoal—A TIME/CM
	------			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x $^3/_{16}$ inch, HSS

FIG. 1 FRONT & SWITCHES *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
1-118	366-0038-00			1	KNOB, red—VARIABLE A
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x $^3/_{16}$ inch, HSS
-119	262-0766-00			1	SWITCH, wired—A TIME/CM
	- - - - - -			-	switch includes:
	260-0756-00			1	SWITCH, unwired—A TIME/CM
-120	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0413-00			2	NUT, hex., $^3/_8$-32 x $^1/_2$ inch
-121	210-0255-00			1	LUG, solder, $^3/_8$ ID x 0.500 inch OD, SE
-122	407-0215-00			1	BRACKET, switch mounting
	- - - - - -			-	mounting hardware: (not included w/bracket)
	210-0006-00			2	LOCKWASHER, internal, #6
	210-0449-00			2	NUT, hex., 5-40 x $^1/_4$ inch
	179-1073-00			1	CABLE HARNESS, time/cm switch
-123	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
-124	210-0457-00			2	NUT, keps, 6-32 x $^5/_{16}$ inch
	210-0407-00			2	NUT, hex., 6-32 x $^1/_4$ inch
-125	348-0055-00			1	GROMMET, plastic, $^1/_4$ inch diameter
-126	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
	210-0018-00			1	LOCKWASHER, internal, $^5/_{16}$ inch
-127	210-0524-00			1	NUT, hex., $^{15}/_{16}$ x $^1/_2$ inch
-128	384-0389-00			1	ROD, external shaft 0.125 dia x 8 inches long
-129	376-0014-00			1	COUPLING, wire, steel
	- - - - - -			-	mounting hardware: (not included w/switch)
	210-0012-00			1	LOCKWASHER, internal, $^3/_8$ ID x $^1/_2$ inch OD
	210-0590-00			1	NUT, hex., $^3/_8$-32 x $^7/_{16}$ inch
	211-0507-00			2	SCREW, 6-32 x $^5/_{16}$ inch, PHS
-130	366-0360-00			1	KNOB, charcoal—ASTIGMATISM A
	- - - - - -			-	knob includes:
	213-0020-00			1	SCREW, set, 6-32 x $^1/_8$ inch, HSS
-131	366-0283-00			1	KNOB, charcoal—CONTRAST (A INTENS BY B)
-132	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0013-00			1	LOCKWASHER, internal, $^3/_8$ ID x $^{11}/_{16}$ inch OD
	210-0978-00			1	WASHER, flat, $^3/_8$ ID x $^1/_2$ inch OD
	210-0590-00			1	NUT, hex., $^3/_8$-32 x $^7/_{16}$ inch
-133	366-0220-00			1	KNOB, charcoal—FOCUS A
	- - - - - -			-	knob includes:
	213-0020-00			1	SCREW, set, 6-32 x $^1/_8$ inch, HSS

FIG. 1 FRONT & SWITCHES *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
1-134	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0013-00			1	LOCKWASHER, internal, 3/8 ID x 11/16 inch OD
	210-0978-00			1	WASHER, flat, 3/8 ID x 1/2 inch OD
	210-0590-00			1	NUT, hex., 3/8-32 x 7/16 inch
-135	366-0220-00			1	KNOB, charcoal—INTENSITY A
	- - - - - -			-	knob includes:
	213-0020-00			1	SCREW, set, 6-32 x 1/8 inch, HSS
-136	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0013-00			1	LOCKWASHER, internal, 3/8 ID x 11/16 inch OD
	210-0978-00			1	WASHER, flat, 3/8 ID x 1/2 inch OD
	210-0413-00			1	NUT, hex., 3/8-32 x 7/16 inch
-137	366-0160-00			1	KNOB, charcoal—UPPER BEAM DISPLAY
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
-138	366-0081-00			1	KNOB, red—POSITION A
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
-139	262-0768-00	100	2009	1	SWITCH, wired—UPPER BEAM DISPLAY
	260-0768-01	2010		1	SWITCH, wired—UPPER BEAM DISPLAY
	- - - - - -			-	switch includes:
	260-0752-00	100	2009	1	SWITCH, unwired—UPPER BEAM DISPLAY
	260-0752-01	2010		1	SWITCH, unwired
-140	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0012-00			1	LOCKWASHER, internal, 3/8 ID x 1/2 inch OD
-141	210-0413-00			2	NUT, hex., 3/8-32 x 1/2 inch
-142	376-0014-00			1	COUPLING, wire, steel
-143	384-0390-00			1	ROD, external shaft, 0.125 dia x 4.074 inches long
	- - - - - -			-	mounting hardware: (not included w/switch)
	211-0008-00			2	SCREW, 4-40 x 1/4 inch, PHS
	210-0013-00			1	LOCKWASHER, internal, 3/8 ID x 1/2 inch OD
	210-0590-00			1	NUT, hex., 3/8-32 x 7/16 inch
-144	366-0173-00			1	KNOB, charcoal—LEVEL A
	- - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch, HSS
-145	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0978-00			1	WASHER, flat, 3/8 ID x 1/2 inch OD
	210-0590-00			1	NUT, hex., 3/8-32 x 7/16 inch

FIG. 1 FRONT & SWITCHES *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
1-146	210-0255-00			2	LUG, solder, $^3/_8$ inch
-147	337-0852-00			2	GUARD, shielding, gasket, outside
-148	337-0851-00			1	GUARD, shielding, gasket, A inside
-149	337-0856-00			2	GUARD, shielding, gasket, top
-150	337-0853-00			2	GUARD, shielding, gasket, bottom
-151	016-0088-00			10	ASSEMBLY, cover, BNC w/retaining strap
	- - - - - -			-	each assembly includes:
-152	200-0678-00			1	COVER, BNC
-153	346-0045-00			1	STRAP, plastic
-154	366-0283-00	X2010		1	KNOB, charcoal—CONTRAST (A INTENS BY B)

FIG. 2 A SWEEP, VERTICAL AMPLIFIER & HIGH VOLTAGE

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
2-1	441-0655-00	100	2009	1	CHASSIS, A Sweep
	441-0655-01	2010		1	CHASSIS, A SWEEP
	- - - - - -			-	mounting hardware: (not included w/chassis)
	211-0559-00			4	SCREW, 6-32 x $^3/_8$ inch, 100° csk, FHS
	212-0040-00			1	SCREW, 8-32 x $^3/_8$ inch, 100° csk, FHS
	212-0004-00			2	SCREW, 8-32 x $^5/_{16}$ inch, PHS
-2	670-0431-00			1	ASSEMBLY, circuit board
	- - - - - -			-	assembly includes:
	260-0552-00			1	SWITCH, reed
-3	136-0220-00			2	SOCKET, transistor, 3 pin
	388-0696-00			1	BOARD, circuit
	- - - - - -			-	board includes:
-4	214-0506-00			12	PIN, connector, straight, male
	- - - - - -			-	mounting hardware: (not included w/assembly)
-5	211-0601-00			3	SCREW, sems, 6-32 x $^5/_{16}$ inch, PHB
-6	129-0088-00			3	POST, hex., 0.250 dia x 0.700 inch long
	210-0006-00			3	LOCKWASHER, internal, #6
-7	- - - - - -			1	RESISTOR
	- - - - - -			-	mounting hardware: (not included w/resistor)
-8	211-0544-00			1	SCREW, 6-32 x $^3/_4$ inch, THS
-9	210-0478-00			1	NUT, hex., $^5/_{16}$ x $^{21}/_{32}$ inch long
	211-0507-00			1	SCREW, 6-32 x $^5/_{16}$ inch, PHS
-10	136-0181-00	100	2009	19	SOCKET, transistor, 3 pin
	136-0181-00	2010		20	SOCKET, transistor, 3 pin
	- - - - - -			-	mounting hardware for each: (not included w/socket)
-11	354-0234-00			1	RING, socket mounting
-12	- - - - - -			2	COIL
	- - - - - -			-	mounting hardware for each: (not included w/coil)
-13	407-0236-01			1	BRACKET, plastic, coil mounting
	212-0004-00			1	SCREW, 8-32 x $^5/_{16}$ inch, PHS
-14	200-0642-00			2	CAP, $^1/_4$ inch
-15	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
-16	386-0255-00			1	PLATE, flange, metal capacitor mounting
-17	211-0534-00			2	SCREW, sems, 6-32 x $^5/_{16}$ inch, PHS
	210-0457-00			2	NUT, keps, 6-32 x $^5/_{16}$ inch

FIG. 2 A SWEEP, VERTICAL AMPLIFIER & HIGH VOLTAGE *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
2-18	337-0813-00			1	SHIELD
	- - - - - -			-	mounting hardware: (not included w/shield)
	210-0586-00			2	NUT, keps, 4-40 x 1/4 inch
-19	- - - - - -			2	RESISTOR, variable
	- - - - - -			-	mounting hardware for each: (not included w/resistor)
	210-0207-00			1	LUG, solder, 3/8 ID x 5/8 inch OD, SE
	210-0012-00			1	LOCKWASHER, internal, 3/8 ID x 1/2 inch OD
	210-0840-00			1	WASHER, flat, 0.390 ID x 9/16 inch OD
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
-20	- - - - - -			3	RESISTOR, variable
	- - - - - -			-	mounting hardware for each: (not included w/resistor)
	210-0840-00			1	WASHER, flat, 0.390 ID x 9/16 inch OD
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
-21	136-0158-00			2	SOCKET, tube, 12 pin, w/ground lugs
	- - - - - -			-	mounting hardware for each: (not included w/socket)
-22	213-0044-00			2	SCREW, thread forming, 5-32 x 3/16 inch, PHS
-23	210-0201-00			11	LUG, solder, SE #4
	- - - - - -			-	mounting hardware for each: (not included w/lug)
	213-0044-00			1	SCREW, thread forming, 5-32 x 3/16 inch, PHS
-24	210-0204-00			4	LUG, solder, DE #6
	- - - - - -			-	mounting hardware for each: (not included w/lug)
	213-0044-00			1	SCREW, thread forming, 5-32 x 3/16 inch, PHS
-25	- - - - - -			2	CAPACITOR
	- - - - - -			-	mounting hardware for each: (not included w/capacitor)
-26	384-0542-00			1	ROD, plastic, 5/16 x 1 inch long
-27	211-0507-00			1	SCREW, 6-32 x 5/16 inch, PHS
-28	136-0174-00			2	SOCKET, tube, 9 pin, w/ground lugs
	- - - - - -			-	mounting hardware for each: (not included w/socket)
	213-0044-00			2	SCREW, thread forming, 5-32 x 3/16 inch, PHS
-29	136-0015-00			9	SOCKET, tube, 9 pin, w/ground lugs
	- - - - - -			-	mounting hardware for each: (not included w/socket)
	213-0044-00			2	SCREW, thread forming, 5-32 x 3/16 inch, PHS
-30	136-0008-00			1	SOCKET, tube, 7 pin, w/ground lugs
	- - - - - -			-	mounting hardware: (not included w/socket)
-31	213-0044-00			2	SCREW, thread forming, 5-32 x 3/16 inch, PHS

FIG. 2 A SWEEP, VERTICAL AMPLIFIER & HIGH VOLTAGE *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
2-32	337-0005-00			1	SHIELD, socket, STS179
	- - - - - -			-	mounting hardware: (not included w/shield)
	213-0044-00			2	SCREW, thread forming, 5-32 x $^3/_{16}$ inch, PHS
-33	337-0008-00			1	SHIELD, tube, 1$^1/_{32}$ ID x 2$^{13}/_{32}$ inches h, w/spring
-34	348-0050-00			2	GROMMET, plastic, $^3/_4$ inch diameter
-35	348-0056-00			1	GROMMET, plastic, $^3/_8$ inch diameter
-36	348-0031-00			6	GROMMET, plastic, $^5/_{32}$ inch diameter
-37	348-0055-00			2	GROMMET, plastic, $^1/_4$ inch diameter
-38	385-0151-00			2	ROD, plastic, $^5/_{16}$ OD x 2$^9/_{16}$ inches long
	- - - - - -			-	mounting hardware for each: (not included w/rod)
	211-0507-00			1	SCREW, 6-32 x $^5/_{16}$ inch, PHS
-39	385-0168-00			1	ROD, spacer, hex., $^1/_4$ OD x 1.168 inches long
	- - - - - -			-	mounting hardware: (not included w/rod)
	210-0006-00			1	LOCKWASHER, internal, #6
	211-0507-00			1	SCREW, 6-32 x $^5/_{16}$ inch, PHS
-40	385-0138-00	100	116	1	ROD, plastic, 1$^9/_{16}$ inches long
	385-0137-00	117		1	ROD, plastic, 2$^1/_4$ inches long
	- - - - - -			-	mounting hardware: (not included w/rod)
	213-0041-00			1	SCREW, thread cutting, 6-32 x $^3/_8$ inch, PHS
-41	337-0790-00			1	SHIELD, top half
	- - - - - -			-	mounting hardware: (not included w/shield)
	210-0457-00			2	NUT, keps, 6-32 x $^5/_{16}$ inch
-42	337-0789-00			1	SHIELD, bottom half
	- - - - - -			-	mounting hardware: (not included w/shield)
-43	211-0007-00			2	SCREW, 4-40 x $^3/_{16}$ inch, PHS
	210-0457-00			2	NUT, keps, 6-32 x $^5/_{16}$ inch
-44	- - - - - -			2	RESISTOR, variable
	- - - - - -			-	mounting hardware for each: (not included w/resistor)
	210-0940-00			1	WASHER, flat, $^1/_4$ ID x $^3/_8$ inch OD
	210-0583-00			1	NUT, hex., $^1/_4$-32 x $^5/_{16}$ inch
-45	337-0792-00			1	SHIELD, high voltage
	- - - - - -			-	mounting hardware: (not included w/shield)
	210-0457-00			5	NUT, keps, 6-32 x $^5/_{16}$ inch
-46	200-0645-00			1	COVER, high voltage
	- - - - - -			-	mounting hardware: (not included w/cover)
-47	211-0097-00			4	SCREW, 4-40 x $^5/_{16}$ inch, PHS

FIG. 2 A SWEEP, VERTICAL AMPLIFIER & HIGH VOLTAGE *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
2-48	386-1099-00			1	PLATE, CRT shield
	- - - - - -			-	mounting hardware: (not included w/plate)
-49	211-0008-00			4	SCREW, 4-40 x 1/4 inch, PHS
-50	407-0242-00			4	BRACKET, angle
	211-0507-00			4	SCREW, 6-32 x 5/16 inch, PHS
-51	343-0007-00			4	CLAMP, cable, 5/8 inch plastic
-52	441-0659-00			1	CHASSIS, vertical amplifier "A"
	- - - - - -			-	mounting hardware: (not included w/chassis)
	212-0004-00			2	SCREW, 8-32 x 5/16 inch, PHS
	212-0040-00			2	SCREW, 8-32 x 3/8 inch, 100° csk, FHS
-53	348-0063-00			1	GROMMET, plastic, 1/2 inch diameter
-54	348-0056-00			3	GROMMET, plastic, 3/8 inch diameter
-55	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0840-00			1	WASHER, flat, 0.390 ID x 9/16 inch OD
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
	210-0207-00			1	LUG, solder, 3/8 ID x 5/8 inch OD, SE
	210-0012-00			1	LOCKWASHER, internal, 3/8 ID x 1/2 inch OD
-56	210-0201-00			8	LUG, solder, SE #4
	- - - - - -			-	mounting hardware for each: (not included w/lug)
	213-0044-00			1	SCREW, thread forming, 5-32 x 3/16 inch, PHS
-57	210-0204-00			1	LUG, solder, DE #6
	- - - - - -			-	mounting hardware: (not included w/lug)
	213-0044-00			1	SCREW, thread forming, 5-32 x 3/16 inch, PHS
-58	252-0564-00			ft.	PLASTIC, extruded channel (specify 3 3/8 inches long)
-59	136-0015-00			1	SOCKET, tube, 9 pin, w/ground lugs
	- - - - - -			-	mounting hardware: (not included w/socket)
	213-0044-00			2	SCREW, thread forming, 5-32 x 3/16 inch, PHS
-60	136-0181-00			18	SOCKET, transistor, 3 pin
	- - - - - -			-	mounting hardware for each: (not included w/socket)
-61	354-0234-00			1	RING, socket mounting
-62	385-0168-00			1	ROD, spacer, 1/4 inch hex., x 1.168 inches long
	- - - - - -			-	mounting hardware: (not included w/rod)
	210-0006-00			1	LOCKWASHER, internal, #6
-63	- - - - - -			3	CAPACITOR
	- - - - - -			-	mounting hardware for each: (not included w/capacitor)
-64	214-0153-00			1	FASTENER, plastic, snapin

FIG. 2 A SWEEP, VERTICAL AMPLIFIER & HIGH VOLTAGE *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
2-65	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
-66	432-0048-00			1	BASE, plastic, capacitor mounting
	386-0255-00			1	PLATE, metal, capacitor mounting
	211-0516-00			2	SCREW, 6-32 x 7/8 inch, PHS
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-67	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
-68	432-0047-00			1	BASE, plastic, capacitor mounting
-69	386-0252-00			1	PLATE, fiber, capacitor mounting
	211-0516-00			2	SCREW, 6-32 x 7/8 inch, PHS
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-70	200-0533-00			1	COVER, capacitor, 1 ID x 0.750 inch long
-71	344-0116-00			1	CLIP, capacitor mounting
-72	- - - - - -			2	COIL
	- - - - - -			-	mounting hardware for each: (not included w/coil)
	213-0044-00			1	SCREW, thread forming, 5-32 x 3/16 inch, PHS
-73	119-0069-00			1	ASSEMBLY, delay line
	- - - - - -			-	assembly includes:
-74	131-0271-00			2	CONNECTOR, cable termination
-75	380-0049-00			1	HOUSING, delay line
-76	200-0482-00	100	2009	1	COVER, delay line
	200-0482-06	2010		1	COVER, delay line
	- - - - - -			-	mounting hardware: (not included w/cover)
	211-0514-00			3	SCREW, 6-32 x 3/4 inch, PHS
	210-0407-00			3	NUT, hex., 6-32 x 1/4 inch
	- - - - - -			-	mounting hardware: (not included w/assembly)
-77	211-0516-00			2	SCREW, 6-32 x 7/8 inch, PHS
-78	385-0018-00			2	ROD, plastic, 5/16 x 1 1/4 inches long
-79	211-0510-00			1	SCREW, 6-32 x 3/8 inch, PHS
-80	392-0147-00			1	ASSEMBLY, high voltage board
	- - - - - -			-	assembly includes:
-81	124-0162-00			1	STRIP, ceramic, 7/16 inch h, w/4 notches
	- - - - - -			-	strip includes:
-82	355-0046-00			1	STUD, plastic
	- - - - - -			-	mounting hardware: (not included w/strip)
-83	361-0007-00			1	SPACER, plastic, 0.156 inch long
-84	346-0032-00			1	STRAP, mousetail, rubber, 0.075 dia x 4 inches long
-85	124-0164-00			2	STRIP, ceramic, 0.437 inch h, w/4 notches
-86	124-0163-00			4	STRIP, ceramic, 0.437 inch h, w/2 notches
	- - - - - -			-	mounting hardware: (not included w/assembly)
	211-0507-00			1	SCREW, 6-32 x 5/16 inch, PHS

FIG. 2 A SWEEP, VERTICAL AMPLIFIER & HIGH VOLTAGE *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
2-87	- - - - - -			1	TRANSFORMER
	- - - - - -			-	mounting hardware: (not included w/transformer)
-88	211-0521-00			2	SCREW, 6-32 x 1 1/2 inches, RHS
-89	210-0869-00			2	WASHER, plastic, 5/32 ID x 3/8 inch OD
-90	200-0475-00			1	COVER, high voltage box
-91	337-0814-00			1	SHIELD, high voltage
	- - - - - -			-	mounting hardware: (not included w/shield)
-92	211-0530-00			2	SCREW, 6-32 x 1 3/4 inches, PHS
-93	210-0716-00			2	WASHER, plastic insulating
-94	166-0357-00			1	SLEEVE, plastic, anode lead
-95	166-0319-00			2	SLEEVE, plastic, insulating
-96	380-0048-00			1	HOUSING, high voltage
	- - - - - -			-	mounting hardware: (not included w/housing)
	211-0507-00			2	SCREW, 6-32 x 5/16 inch, PHS
	211-0542-00			1	SCREW, 6-32 x 5/16 inch, THS
-97	179-1069-00			1	CABLE HARNESS, high voltage #1
-98	179-1071-00			1	CABLE HARNESS, high voltage #2
-99	179-1054-00	100	2009	1	CABLE HARNESS, "A" Sweep #2
	179-1054-01	2010		1	CABLE HARNESS, "A" SWEEP #2
-100	179-1067-00			1	CABLE HARNESS, high voltage
-101	179-1053-00	100	2009	1	CABLE HARNESS, "A" Sweep #1
	179-1053-01	2010		1	CABLE HARNESS, "A" SWEEP #1
-102	124-0145-00			11	STRIP, ceramic, 7/16 inch h, w/20 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, plastic, 0.406 inch long
-103	124-0146-00			14	STRIP, ceramic, 7/16 inch h, w/16 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, plastic, 0.406 inch long
-104	124-0162-00			1	STRIP, ceramic, 7/16 inch h, w/4 notches
	- - - - - -			-	strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware: (not included w/strip)
	361-0009-00			2	SPACER, plastic, 0.406 inch long
-105	124-0149-00			2	STRIP, ceramic, 7/16 inch h, w/7 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, plastic, 0.406 inch long

FIG. 2 A SWEEP, VERTICAL AMPLIFIER & HIGH VOLTAGE *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
2-106	124-0147-00			1	STRIP, ceramic, $^7/_{16}$ inch h, w/13 notches
	- - - - - -			-	strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware: (not included w/strip)
	361-0009-00			2	SPACER, plastic, 0.406 inch long
-107	124-0147-00			2	STRIP, ceramic, $^7/_{16}$ inch h, w/13 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0007-00			2	SPACER, plastic, 0.188 inch long
-108	124-0148-00			1	STRIP, ceramic, $^7/_{16}$ inch h, w/9 notches
	- - - - - -			-	strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware: (not included w/strip)
	361-0009-00			2	SPACER, plastic, 0.406 inch long
-109	124-0089-00			4	STRIP, ceramic, $^3/_4$ inch h, w/7 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, plastic, 0.406 inch long
-110	179-1061-00	100	2009	1	CABLE HARNESS, left Vertical Amplifier
	179-1061-01	2010		1	CABLE HARNESS, left Vertical Amplifier
-111	179-1063-00			1	CABLE HARNESS, left coaxial
-112	124-0145-00			2	STRIP, ceramic, $^7/_{16}$ inch h, w/20 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, plastic, 0.406 inch long
-113	124-0147-00			10	STRIP, ceramic, $^7/_{16}$ inch h, w/13 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, plastic, 0.406 inch long
-114	385-0138-00	X117		1	ROD, plastic, 1$^9/_{16}$ inches long
	- - - - - -			-	mounting hardware: (not included w/rod)
	213-0041-00			1	SCREW, thread cutting, 6-32 x $^3/_8$ inch, THS

FIG. 3 B SWEEP VERTICAL AMPLIFIER & HIGH VOLTAGE

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
3-1	441-0656-00	100	2009	1	CHASSIS, "B" sweep
	441-0656-01	2010		1	CHASSIS, "B" sweep
	- - - - - -			-	mounting hardware: (not included w/chassis)
	211-0559-00			4	SCREW, 6-32 x $^{3}/_{8}$ inch, 100° csk, FHS
	212-0040-00			1	SCREW, 8-32 x $^{3}/_{8}$ inch, 100° csk, FHS
	212-0004-00			2	SCREW, 8-32 x $^{5}/_{16}$ inch, PHS
-2	670-0432-00			1	ASSEMBLY, circuit board
	- - - - - -			-	assembly includes:
	260-0552-00			1	SWITCH, reed
-3	136-0220-00			2	SOCKET, transistor, 3 pin
	388-0696-00			1	BOARD, circuit
	- - - - - -			-	board includes:
-4	214-0506-00			12	PIN, connector, straight, male
	- - - - - -			-	mounting hardware: (not included w/assembly)
-5	211-0601-00			3	SCREW, sems, 6-32 x $^{5}/_{16}$ inch, PHB
-6	129-0088-00			3	POST, hex., 0.250 dia x 0.700 inch long
	210-0006-00			3	LOCKWASHER, internal, #6
-7	- - - - - -			1	RESISTOR
	- - - - - -			-	mounting hardware: (not included w/resistor)
-8	211-0544-00			1	SCREW, 6-32 x $^{3}/_{4}$ inch, THS
-9	210-0478-00			1	NUT, hex., alum. $^{5}/_{16}$ x $^{21}/_{32}$ inch long
	211-0507-00			1	SCREW, 6-32 x $^{5}/_{16}$ inch, PHS
-10	136-0181-00	100	2009	21	SOCKET, transistor, 3 pin
	136-0181-00	2010		20	SOCKET, transistor, 3 pin
	- - - - - -			-	mounting hardware for each: (not included w/socket)
-11	354-0234-00			1	RING, socket mounting
-12	- - - - - -			2	COIL
	- - - - - -			-	mounting hardware for each: (not included w/coil)
-13	407-0236-01			1	BRACKET, plastic, coil mounting
	212-0004-00			1	SCREW, 8-32 x $^{5}/_{16}$ inch, PHS
-14	200-0642-00			2	CAP, $^{1}/_{4}$ inch
-15	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
-16	386-0255-00			1	PLATE, flange, metal, capacitor mounting
-17	211-0534-00			2	SCREW, sems, 6-32 x $^{5}/_{16}$ inch, PHS
	210-0457-00			2	NUT, keps, 6-32 x $^{5}/_{16}$ inch
-18	337-0813-00			1	SHIELD
	- - - - - -			-	mounting hardware: (not included w/shield)
	210-0586-00			2	NUT, keps, 4-40 x $^{1}/_{4}$ inch

FIG. 3 B SWEEP VERTICAL AMPLIFIER & HIGH VOLTAGE *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
3-19	343-0002-00			1	CLAMP, cable, $^3/_{16}$ inch, plastic
	- - - - - -			-	mounting hardware: (not included w/clamp)
-20	211-0507-00			1	SCREW, 6-32 x $^5/_{16}$ inch, PHS
-21	210-0863-00			1	WASHER, D type
	210-0457-00			1	NUT, keps, 6-32 x $^5/_{16}$ inch
-22	- - - - - -			2	RESISTOR, variable
	- - - - - -			-	mounting hardware for each: (not included w/resistor)
	210-0207-00			1	LUG, solder, $^3/_8$ ID x $^5/_8$ inch OD, SE
	210-0012-00			1	LOCKWASHER, internal, $^3/_8$ ID x $^1/_2$ inch OD
	210-0840-00			1	WASHER, flat, 0.390 ID x $^9/_{16}$ inch OD
	210-0413-00			1	NUT, hex., $^3/_8$-32 x $^1/_2$ inch
-23	- - - - - -			3	RESISTOR, variable
	- - - - - -			-	mounting hardware for each: (not included w/resistor)
	210-0840-00			1	WASHER, flat, 0.390 ID x $^9/_{16}$ inch OD
	210-0413-00			1	NUT, hex., $^3/_8$-32 x $^1/_2$ inch
	210-0255-00			1	LUG, solder, $^3/_8$ ID x 0.500 inch OD
-24	136-0158-00			2	SOCKET, tube, 12 pin, w/ground lugs
	- - - - - -			-	mounting hardware for each: (not included w/socket)
-25	213-0044-00			2	SCREW, thread forming, 5-32 x $^3/_{16}$ inch, PHS
-26	210-0201-00			12	LUG, solder, SE #4
	- - - - - -			-	mounting hardware for each: (not included w/lug)
	213-0044-00			1	SCREW, thread forming, 5-32 x $^3/_{16}$ inch, PHS
-27	210-0204-00			4	LUG, solder, DE #6
	- - - - - -			-	mounting hardware for each: (not included w/lug)
	213-0044-00			1	SCREW, thread forming, 5-32 x $^3/_{16}$ inch, PHS
-28	- - - - - -			2	CAPACITOR
	- - - - - -			-	mounting hardware for each: (not included w/capacitor)
-29	384-0542-00			1	ROD, plastic, $^5/_{16}$ dia x 1 inch long
	211-0507-00			1	SCREW, 6-32 x $^5/_{16}$ inch, PHS
-30	136-0174-00			2	SOCKET, tube, 9 pin, w/ground lugs
	- - - - - -			-	mounting hardware for each: (not included w/socket)
	213-0044-00			2	SCREW, thread forming, 5-32 x $^3/_{16}$ inch, PHS
-31	136-0015-00			9	SOCKET, tube, 9 pin, w/ground lugs
	- - - - - -			-	mounting hardware for each: (not included w/socket)
-32	213-0044-00			2	SCREW, thread forming, 5-32 x $^3/_{16}$ inch, PHS

FIG. 3 B SWEEP VERTICAL AMPLIFIER & HIGH VOLTAGE *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
3-33	136-0008-00			1	SOCKET, tube, 7 pin, w/ground lugs
	- - - - - -			-	mounting hardware: (not included w/socket)
	213-0044-00			2	SCREW, thread forming, 5-32 x 3/16 inch, PHS
-34	337-0005-00			1	SHIELD, socket, STS179
	- - - - - -			-	mounting hardware: (not included w/shield)
	213-0044-00			2	SCREW, thread forming, 5-32 x 3/16 inch, PHS
-35	337-0008-00			1	SHIELD, 1 1/32 ID x 2 13/32 inches h, w/spring
-36	348-0050-00			2	GROMMET, plastic, 3/4 inch diameter
-37	348-0056-00			1	GROMMET, plastic, 3/8 inch diameter
-38	348-0031-00			6	GROMMET, plastic, 5/32 inch diameter
-39	348-0055-00			2	GROMMET, plastic, 1/4 inch diameter
-40	385-0151-00			2	ROD, plastic, 5/16 x 2 9/16 inches long
	- - - - - -			-	mounting hardware for each: (not included w/rod)
	211-0507-00			1	SCREW, 6-32 x 5/16 inch, PHS
-41	385-0168-00			1	ROD, spacer, 1/4 hex., x 1.168 inches long
	- - - - - -			-	mounting hardware: (not included w/rod)
	210-0006-00			1	LOCKWASHER, internal, #6
	211-0507-00			1	SCREW, 6-32 x 5/16 inch, PHS
-42	385-0138-00	100	116	1	ROD, plastic, 1 9/16 inches long
	385-0137-00	117		1	ROD, plastic, 2 1/4 inches long
	- - - - - -			-	mounting hardware: (not included w/rod)
	213-0041-00			1	SCREW, thread cutting, 6-32 x 3/8 inch, PHS
-43	337-0812-00			1	SHIELD, top half
	- - - - - -			-	mounting hardware: (not included w/shield)
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-44	337-0789-00			1	SHIELD, bottom half
	- - - - - -			-	mounting hardware: (not included w/shield)
-45	211-0007-00			2	SCREW, 4-40 x 3/16 inch, PHS
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-46	- - - - - -			3	RESISTOR, variable
	210-0940-00			1	WASHER, flat, 1/4 ID x 3/8 inch OD
	210-0583-00			1	NUT, hex., 1/4-32 x 5/16 inch
-47	337-0791-00			1	SHIELD, high voltage
	- - - - - -			-	mounting hardware: (not included w/shield)
	210-0457-00			5	NUT, keps, 6-32 x 5/16 inch
-48	200-0644-00			1	COVER, high voltage
	- - - - - -			-	mounting hardware: (not included w/cover)
-49	211-0097-00			4	SCREW, 4-40 x 5/16 inch, PHS

FIG. 3 B SWEEP VERTICAL AMPLIFIER & HIGH VOLTAGE *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
3-50	441-0660-00			1	CHASSIS, vertical amplifier "B"
	- - - - - -			-	mounting hardware: (not included w/chassis)
	212-0004-00			2	SCREW, 8-32 x $^5/_{16}$ inch, PHS
	212-0040-00			2	SCREW, 8-32 x $^3/_8$ inch, FHS
-51	348-0063-00			1	GROMMET, plastic, $^1/_2$ inch diameter
-52	348-0056-00			3	GROMMET, plastic, $^3/_8$ inch diameter
-53	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0840-00			1	WASHER, flat, 0.390 ID x $^9/_{16}$ inch OD
	210-0413-00			1	NUT, hex., $^3/_8$-32 x $^1/_2$ inch
	210-0207-00			1	LUG, solder, $^3/_8$ inch ID
-54	210-0201-00			5	LUG, solder, SE #4
	- - - - - -			-	mounting hardware for each: (not included w/lug)
	213-0044-00			1	SCREW, thread forming, 5-32 x $^3/_{16}$ inch, PHS
-55	210-0204-00			1	LUG, solder, DE #6
	- - - - - -			-	mounting hardware: (not included w/lug)
-56	213-0044-00			1	SCREW, thread forming, 5-32 x $^3/_{16}$ inch, PHS
-57	252-0564-00			ft.	PLASTIC, extruded channel (specify 3$^3/_8$ inches long)
-58	136-0015-00			1	SOCKET, tube, 9 pin, w/ground lugs
	- - - - - -			-	mounting hardware: (not included w/socket)
	213-0044-00			2	SCREW, thread forming, 5-32 x $^3/_{16}$ inch, PHS
-59	136-0181-00			10	SOCKET, transistor, 3 pin
	- - - - - -			-	mounting hardware for each: (not included w/socket)
	354-0234-00			1	RING, socket mounting
-60	385-0168-00			1	ROD, spacer, $^1/_4$ hex., x 1.168 inches long
	- - - - - -			-	mounting hardware: (not included w/rod)
	210-0006-00			1	LOCKWASHER, internal, #6
	211-0507-00			1	SCREW, 6-32 x $^5/_{16}$ inch, PHS
-61	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
-62	214-0153-00			1	FASTENER, snap in, plastic
-63	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
-64	432-0048-00			1	BASE, plastic, capacitor mounting
-65	386-0255-00			1	PLATE, metal, capacitor mounting
	211-0516-00			2	SCREW, 6-32 x $^7/_8$ inch, PHS
-66	210-0457-00			2	NUT, keps, 6-32 x $^5/_{16}$ inch

FIG. 3 B SWEEP VERTICAL AMPLIFIER & HIGH VOLTAGE *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
3-67	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
-68	432-0047-00			1	BASE, plastic, capacitor mounting
-69	386-0252-00			1	PLATE, fiber, capacitor mounting
	211-0516-00			2	SCREW, 6-32 x 7/8 inch, PHS
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-70	200-0533-00			1	COVER, capacitor, 1 ID x 0.750 inches long
-71	344-0116-00			1	CLIP, capacitor mounting
	- - - - - -			-	mounting hardware: (not included w/clip)
	213-0044-00			1	SCREW, thread forming, 5-32 x 3/16 inch
-72	- - - - - -			2	COIL
	- - - - - -			-	mounting hardware for each: (not included w/coil)
	213-0044-00			1	SCREW, thread forming, 5-32 x 3/16 inch
-73	119-0069-00			1	ASSEMBLY, delay line
	- - - - - -			-	assembly includes:
-74	131-0271-00			2	CONNECTOR, cable termination
-75	380-0049-00			1	HOUSING, delay line
-76	200-0482-00	100	2009	1	COVER, delay line
	200-0482-06	2010		1	COVER, delay line
	- - - - - -			-	mounting hardware: (not included w/cover)
-77	211-0514-00			3	SCREW, 6-32 x 3/4 inch, PHS
	210-0407-00			3	NUT, hex., 6-32 x 1/4 inch
	- - - - - -			-	mounting hardware: (not included w/assembly)
-78	211-0516-00			2	SCREW, 6-32 x 7/8 inch, PHS
-79	385-0018-00			2	ROD, plastic, 5/16 x 1 1/4 inches long
	211-0507-00			2	SCREW, 6-32 x 5/16 inch, PHS
-80	211-0510-00			1	SCREW, 6-32 x 3/8 inch, PHS
-81	392-0147-00			1	ASSEMBLY, High Voltage board
	- - - - - -			-	assembly includes:
-82	124-0162-00			1	STRIP, ceramic, 7/16 inch h, w/4 notches
	- - - - - -			-	strip includes:
-83	355-0046-00			1	STUD, plastic
	- - - - - -			-	mounting hardware: (not included w/strip alone)
-84	361-0007-00			1	SPACER, plastic, 0.156 inch long
	346-0032-00			1	STRAP, rubber, 0.075 dia x 4 inches long
-85	124-0164-00			2	STRIP, ceramic, 0.437 inch h, w/4 notches
-86	124-0163-00			5	STRIP, ceramic, 0.437 inch h, w/2 notches
	- - - - - -			-	mounting hardware: (not included w/assembly)
	211-0507-00			1	SCREW, 6-32 x 5/16 inch, PHS

FIG. 3 B SWEEP VERTICAL AMPLIFIER & HIGH VOLTAGE *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
3-87	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
-88	211-0587-00			1	SCREW, 6-32 x $^{3}/_{16}$ inch, HHS
-89	210-0261-00			2	LUG, solder, high voltage
	210-0966-00			2	WASHER, rubber, $^{7}/_{16}$ ID x $^{7}/_{8}$ inch OD
-90	211-0542-00			1	SCREW, 6-32 x $^{5}/_{16}$ inch, THS
-91	- - - - - -			1	TRANSFORMER
	- - - - - -			-	mounting hardware: (not included w/transformer)
-92	211-0521-00			2	SCREW, 6-32 x 1$^{1}/_{2}$ inches, RHS
-93	210-0869-00			2	WASHER, plastic, $^{5}/_{32}$ ID x $^{3}/_{8}$ inch OD
-94	200-0475-00			1	COVER, high voltage box
-95	337-0814-00			1	SHIELD, high voltage
	- - - - - -			-	mounting hardware: (not included w/shield)
-96	211-0530-00			2	SCREW, 6-32 x 1$^{3}/_{4}$ inches, PHS
-97	214-0716-00			2	WASHER, plastic, insulating
-98	166-0357-00			1	SLEEVE, plastic, anode lead
-99	166-0319-00			2	SLEEVE, plastic, w/o hole
-100	380-0048-00			1	HOUSING, high voltage box
	- - - - - -			-	mounting hardware: (not included w/housing)
	211-0507-00			2	SCREW, 6-32 x $^{5}/_{16}$ inch, PHS
	211-0542-00			1	SCREW, 6-32 x $^{5}/_{16}$ inch, THS
	210-0006-00	X270		1	LOCKWASHER, internal, #6
-101	179-1070-00			1	CABLE HARNESS, high voltage #1
-102	179-1071-00			1	CABLE HARNESS, high voltage #2
-103	214-0210-00			1	ASSEMBLY, solder spool
	- - - - - -			-	assembly includes:
	214-0209-00			1	SPOOL, w/o solder
	- - - - - -			-	mounting hardware: (not included w/assembly)
	361-0007-00			1	SPACER, plastic, 0.188 inch long
-104	179-1055-00	100	2009	1	CABLE HARNESS, "B" sweep
	179-1055-01	2010		1	CABLE HARNESS, "B" SWEEP
-105	179-1068-00			1	CABLE HARNESS, "B" sweep high voltage
-106	124-0145-00			11	STRIP, ceramic, $^{7}/_{16}$ inch h, w/20 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, plastic, 0.406 inch long
-107	124-0146-00			14	STRIP, ceramic, $^{7}/_{16}$ inch h, w/16 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, plastic, 0.406 inch long

FIG. 3 B SWEEP VERTICAL AMPLIFIER & HIGH VOLTAGE *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
3-108	124-0162-00			1	STRIP, ceramic, $^7/_{16}$ inch h, w/4 notches
	- - - - - -			-	strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware: (not included w/strip)
	361-0009-00			2	SPACER, plastic, 0.406 inch long
-109	124-0149-00			2	STRIP, ceramic, $^7/_{16}$ inch h, w/7 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, plastic, 0.406 inch long
-110	124-0147-00			1	STRIP, ceramic, $^7/_{16}$ inch h, w/13 notches
	- - - - - -			-	strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware: (not included w/strip)
	361-0009-00			2	SPACER, plastic, 0.406 inch long
-111	124-0147-00			2	STRIP, ceramic, $^7/_{16}$ inch h, w/13 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0007-00			2	SPACER, plastic, 0.188 inch long
-112	124-0148-00			1	STRIP, ceramic, $^7/_{16}$ inch h, w/9 notches
	- - - - - -			-	strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware: (not included w/strip)
	361-0009-00			2	SPACER, plastic, 0.406 inch long
-113	124-0089-00			4	STRIP, ceramic, $^3/_4$ inch h, w/7 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, plastic, 0.406 inch long
-114	179-1062-00			1	CABLE HARNESS, right vertical amplifier
-115	179-1064-00			1	CABLE HARNESS, coaxial #1
-116	179-1065-00			1	CABLE HARNESS, coaxial #2
-117	124-0145-00			2	STRIP, ceramic, $^7/_{16}$ inch h, w/20 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, plastic, 0.406 inch long

FIG. 3 B SWEEP VERTICAL AMPLIFIER & HIGH VOLTAGE *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
3-118	124-0147-00			6	STRIP, ceramic, $^7/_{16}$ inch h, w/13 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, plastic, 0.406 inch long
-119	385-0138-00	X117		1	ROD, plastic, 1$^9/_{16}$ inches long
	- - - - - -			-	mounting hardware: (not included w/rod)
	213-0041-00			1	SCREW, thread cutting, 6-32 x $^3/_8$ inch, THS
-120	670-0514-00			1	ASSEMBLY, circuit board, high voltage delay
	- - - - - -			-	assembly includes:
	388-0822-00			1	BOARD, circuit
	136-0220-00			1	SOCKET, transistor, 3 pin

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FIG. 4 CAPACITOR MOUNTING CHASSIS & TRANSFORMER

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
4-1	441-0654-00			1	CHASSIS, capacitor mounting
	- - - - - -			-	mounting hardware: (not included w/chassis)
	212-0004-00			12	SCREW, 8-32 x 5/16 inch, PHS
-2	343-0089-00			3	CLAMP, plastic, snap-in
-3	352-0025-00			2	HOLDER, fuse, dual 3AG
	- - - - - -			-	mounting hardware for each: (not included w/holder)
	213-0146-00			2	SCREW, thread forming, 6-32 x 5/16 inch, PHS
-4	- - - - - -			1	THERMAL CUTOUT
	- - - - - -			-	mounting hardware: (not included w/thermal cutout)
-5	213-0044-00			2	SCREW, thread forming, 5-32 x 3/16 inch, PHS
-6	348-0050-00			1	GROMMET, plastic, 3/4 inch diameter
-7	348-0063-00			1	GROMMET, plastic, 1/2 inch diameter
-8	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
-9	407-0270-00			2	BRACKET, capacitor mounting
	210-0006-00			2	LOCKWASHER, internal, #6
-10	210-0407-00			2	NUT, hex., 6-32 x 1/4 inch
-11	- - - - - -			2	CAPACITOR
	- - - - - -			-	mounting hardware for each: (not included w/capacitor)
-12	432-0048-00			1	BASE, plastic, capacitor mounting
-13	386-0254-00			1	PLATE, fiber, capacitor mounting
-14	211-0588-00			2	SCREW, 6-32 x 3/4 inch, HHS
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-15	- - - - - -			2	CAPACITOR
	- - - - - -			-	mounting hardware for each: (not included w/capacitor)
-16	432-0048-00			1	BASE, plastic, capacitor mounting
-17	386-0255-00			1	PLATE, metal, capacitor mounting
	211-0588-00			2	SCREW, 6-32 x 3/4 inch, HHS
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-18	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
-19	386-0254-00			1	PLATE, fiber, capacitor mounting
	211-0543-00			2	SCREW, 6-32 x 5/16 inch, RHS
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch

FIG. 4 CAPACITOR MOUNTING CHASSIS & TRANSFORMER *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
4-20	200-0293-00			2	COVER, plastic, capacitor, $2^9/_{16}$ inches long
-21	200-0259-00			1	COVER, plastic, capacitor, $3^9/_{16}$ inches long
-22	670-0430-00	100	829	1	ASSEMBLY, circuit board
	670-0430-02	830	2009	1	ASSEMBLY, circuit board
	670-0430-01	2010		1	ASSEMBLY, circuit board
	- - - - - -			-	assembly includes:
	388-0691-00	100	2009	1	BOARD, circuit, power
	- - - - - -			-	board includes:
-23	214-0506-00			129	CONNECTOR, square pin
	337-0607-00			1	SHIELD
	388-0691-01	2010		1	BOARD, circuit
	214-0506-00	2010		129	CONNECTOR, square pin
	337-0607-00	2010		1	SHIELD
	- - - - - -			-	mounting hardware: (not included w/assembly)
-24	211-0601-00			4	SCREW, sems, 6-32 x $^5/_{16}$ inch, PHB
-25	129-0088-00			4	POST, hex., 0.250 dia x 0.700 inch long
-26	210-0006-00			3	LOCKWASHER, internal, #6
	210-0202-00			1	LUG, solder, SE #6, w/2 wire holes
-27	407-0210-00			1	BRACKET, transformer mounting (right)
	- - - - - -			-	mounting hardware: (not included w/bracket)
	212-0004-00			5	SCREW, 8-32 x $^5/_{16}$ inch, PHS
-28	407-0209-00			1	BRACKET, transformer mounting (left)
	- - - - - -			-	mounting hardware: (not included w/bracket)
	212-0004-00			5	SCREW, 8-32 x $^5/_{16}$ inch, PHS
-29	210-0201-00			1	LUG, solder, SE #4, w/2 wire holes
	- - - - - -			-	mounting hardware: (not included w/lug)
	213-0044-00			1	SCREW, thread forming, 5-32 x $^3/_{16}$ inch, PHS
-30	129-0089-00			2	POST, hex., 0.250 dia x 0.830 inch long
	- - - - - -			-	mounting hardware for each: (not included w/post)
	210-0006-00			1	LOCKWASHER, internal, #6
-31	337-0817-01			1	SHIELD, transformer
-32	348-0056-00			1	GROMMET, plastic, $^3/_8$ inch diameter
-33	348-0050-00			1	GROMMET, plastic, $^3/_4$ inch diameter
-34	337-0816-01			1	SHIELD, transformer
-35	- - - - - -			1	TRANSFORMER
	- - - - - -			-	mounting hardware: (not included w/transformer)
	212-0509-00			4	SCREW, 10-32 x $^5/_8$ inch, PHS
	220-0410-00			4	NUT, keps, 10-32 x $^5/_{16}$ inch
-36	179-1057-00	100	2009	1	CABLE HARNESS, capacitor chassis
	179-1057-01	2010		1	CABLE HARNESS, capacitor chassis
-37	179-1058-00	100	2009	1	CABLE HARNESS, transformer #1
	179-1058-01	2010		1	CABLE HARNESS, transformer #1
-38	179-1059-00			1	CABLE HARNESS, transformer #2
-39	348-0056-00			2	GROMMET, plastic, $^3/_8$ inch diameter

FIG. 5 POWER CHASSIS & PLUG-IN HOUSING

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
5-1	441-0657-00	100	2009	1	CHASSIS, power
	441-0657-01	2010		1	CHASSIS, power
	- - - - - -			-	chassis includes:
-2	214-0329-00			2	FASTENER, screw, retractable
	- - - - - -			-	mounting hardware: (not included w/chassis)
-3	214-0639-00			2	HINGE, power chassis
	211-0507-00			4	SCREW, 6-32 x $^{5}/_{16}$ inch, PHS
-4	- - - - - -			2	RESISTOR, variable
	- - - - - -			-	mounting hardware for each: (not included w/resistor)
-5	210-0840-00			1	WASHER, flat, 0.390 ID x $^{9}/_{16}$ inch OD
-6	210-0413-00			1	NUT, hex., $^{3}/_{8}$-32 x $^{1}/_{2}$ inch
-7	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
	210-0012-00			1	LOCKWASHER, internal, $^{3}/_{8}$ ID x $^{1}/_{2}$ inch OD
	210-0840-00			1	WASHER, flat, 0.390 ID x $^{9}/_{16}$ inch OD
	210-0413-00			1	NUT, hex., $^{3}/_{8}$-32 x $^{1}/_{2}$ inch
-8	- - - - - -			2	RESISTOR, variable
	- - - - - -			-	mounting hardware for each: not included w/resistor)
-9	210-0207-00			1	LUG, solder, $^{3}/_{8}$ ID x $^{5}/_{8}$ inch OD, SE
	210-0012-00			1	LOCKWASHER, internal, $^{3}/_{8}$ ID x $^{1}/_{2}$ inch OD
	210-0840-00			1	WASHER, flat, 0.390 ID x $^{9}/_{16}$ inch OD
	210-0413-00			1	NUT, hex., $^{3}/_{8}$-32 x $^{1}/_{2}$ inch
-10	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
-11	210-0255-00			1	LUG, solder, $^{3}/_{8}$ ID x 0.500 inch OD, SE
-12	210-0413-00			1	NUT, hex., $^{3}/_{8}$-32 x $^{1}/_{2}$ inch
-13	348-0064-00			1	GROMMET, plastic, $^{5}/_{8}$ inch diameter
-14	348-0055-00			2	GROMMET, plastic, $^{1}/_{4}$ inch diameter
-15	348-0031-00			7	GROMMET, plastic, $^{5}/_{32}$ inch diameter
-16	136-0014-00			1	SOCKET, tube, 9 pin
	- - - - - -			-	mounting hardware: (not included w/socket)
-17	213-0044-00			2	SCREW, thread forming, 5-32 x $^{3}/_{16}$ inch, PHS
-18	136-0236-00			1	SOCKET, tube, 12 pin
	- - - - - -			-	mounting hardware: (not included w/socket)
	213-0044-00			2	SCREW, thread forming, 5-32 x $^{3}/_{16}$ inch, PHS

FIG. 5 POWER CHASSIS & PLUG-IN HOUSING *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
5-19	210-0201-00			6	LUG, solder, SE #4
	- - - - - -			-	mounting hardware for each: (not included w/lug)
	213-0044-00			1	SCREW, thread forming, 5-32 x $^3/_{16}$ inch, PHS
-20	210-0204-00			2	LUG, solder, DE #6
	- - - - - -			-	mounting hardware for each: (not included w/lug)
	213-0044-00			1	SCREW, thread forming, 5-32 x $^3/_{16}$ inch, PHS
-21	136-0181-00			12	SOCKET, transistor, 3 pin
	- - - - - -			-	mounting hardware for each: (not included w/socket)
-22	354-0234-00			1	RING, socket
-23	344-0124-00	100	2009	2	CLAMP, capacitor mounting
	344-0124-00	2010		3	CLAMP, capacitor mounting
	- - - - - -			-	mounting hardware for each: (not included w/clamp)
	213-0055-00			1	SCREW, thread forming, 2-32 x $^3/_{16}$ inch, PHS
-24	426-0121-00			1	HOLDER, toroid
	- - - - - -			-	mounting hardware: (not included w/holder)
	361-0007-00			1	SPACER, plastic, 0.188 inch long
-25	380-0092-00			1	HOUSING, left, outside
	- - - - - -			-	mounting hardware: (not included w/housing)
-26	212-0004-00			3	SCREW, 8-32 x $^5/_{16}$ inch, PHS
-27	210-0458-00			3	NUT, keps, 8-32 x $^{11}/_{32}$ inch
-28	380-0091-00			1	HOUSING, left, inside
	- - - - - -			-	mounting hardware: (not included w/housing)
	211-0559-00			4	SCREW, 6-32 x $^3/_8$ inch, FHS
	212-0004-00			1	SCREW, 8-32 x $^5/_{16}$ inch, PHS
	210-0458-00			1	NUT, keps, 8-32 x $^{11}/_{32}$ inch
-29	386-1007-01			2	PLATE, electrical shield
	- - - - - -			-	mounting hardware for each: (not included w/plate)
-30	211-0038-00			4	SCREW, 4-40 x $^5/_{16}$ inch, 100° csk, FHS
-31	386-0249-00			1	PLATE, bulkhead, left
	- - - - - -			-	mounting hardware: (not included w/plate)
	212-0011-00			1	SCREW, 8-32 x $^3/_4$ inch, 100° csk, FHS
-32	212-0040-00			5	SCREW, 8-32 x $^3/_8$ inch, 100° csk, FHS
-33	210-0458-00			6	NUT, keps, 8-32 x $^{11}/_{32}$ inch
-34	386-1004-00			2	PLATE, bulkhead cover
	- - - - - -			-	mounting hardware for each: (not included w/plate)
-35	211-0541-00			1	SCREW, 6-32 x $^1/_4$ inch, 100° csk, FHS

FIG. 5 POWER CHASSIS & PLUG-IN HOUSING *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
5-36	131-0018-00			2	CONNECTOR, 16 contact
	- - - - - -			-	mounting hardware for each: (not included w/connector)
-37	211-0014-00			2	SCREW, 4-40 x $1/2$ inch, PHS
-38	166-0031-00	100	2099	2	TUBE, spacer, 0.180 ID x $1/4$ OD x $1/4$ inch long
	166-0030-00	2100		2	TUBE, spacer, 0.180 ID x $1/4$ OD x $3/16$ inch long
-39	210-0586-00			2	NUT, keps, 4-40 x $1/4$ inch
-40	260-0601-00			2	SWITCH, unwired—COMPENSATION
	- - - - - -			-	mounting hardware for each: (not included w/switch)
	211-0504-00			2	SCREW, 6-32 x $1/4$ inch, PHS
-41	366-0271-00			2	KNOB, plastic—COMPENSATION
-42	385-0138-00			2	ROD, plastic, $5/16$ dia x $1\,5/8$ inches long
	- - - - - -			-	mounting hardware for each: (not included w/rod)
	211-0511-00			1	SCREW, 6-32 x $1/2$ inch, PHS
-43	343-0006-00			1	CLAMP, cable, $1/2$ inch, plastic
	- - - - - -			-	mounting hardware: (not included w/clamp)
-44	211-0559-00			1	SCREW, 6-32 x $3/8$ inch, 100° csk, FHS
-45	210-0863-00			1	WASHER, D type
-46	210-0457-00			1	NUT, keps, 6-32 x $5/16$ inch
-47	351-0058-00			8	GUIDE, shoe, plastic, $8\,27/32$ inches long
-48	380-0093-00			1	HOUSING, right, outside
	- - - - - -			-	mounting hardware: (not included w/housing)
-49	212-0004-00			3	SCREW, 8-32 x $5/16$ inch, 100° csk, FHS
-50	210-0458-00			3	NUT, keps, 8-32 x $11/32$ inch
-51	380-0090-00			1	HOUSING, right, inside
	- - - - - -			-	mounting hardware: (not included w/housing)
	211-0559-00			4	SCREW, 6-32 x $3/8$ inch, 100° csk, FHS
	212-0004-00			1	SCREW, 8-32 x $5/16$ inch, PHS
	210-0458-00			1	NUT, keps, 8-32 x $11/32$ inch
-52	386-0250-00			1	PLATE, bulkhead, right
	- - - - - -			-	mounting hardware: (not included w/plate)
	212-0011-00			1	SCREW, 8-32 x $3/4$ inch, 100° csk, FHS
	212-0040-00			5	SCREW, 8-32 x $3/8$ inch, 100° csk, FHS
-53	210-0458-00			6	NUT, keps, 8-32 x $11/32$ inch
-54	343-0002-00			1	CLAMP, cable, $3/16$ inch, plastic
	- - - - - -			-	mounting hardware: (not included w/clamp)
	211-0559-00			1	SCREW, 6-32 x $3/8$ inch, 100° csk, FHS
	210-0863-00			1	WASHER, D type
	210-0457-00			1	NUT, keps, 6-32 x $5/16$ inch

FIG. 5 POWER CHASSIS & PLUG-IN HOUSING *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
5-55	386-0248-00			1	PLATE, bulkhead, top
	- - - - - -			-	mounting hardware: (not included w/plate)
	211-0559-00			2	SCREW, 6-32 x 3/8 inch
	210-0457-00			4	NUT, keps, 6-32 x 5/16 inch
-56	343-0006-00			2	CLAMP, cable, 1/2 inch, plastic
	- - - - - -			-	mounting hardware for each: (not included w/clamp)
-57	212-0011-00			1	SCREW, 8-32 x 3/4 inch, 100° csk, FHS
-58	210-0863-00			1	WASHER, D type
-59	210-0458-00			1	NUT, keps, 8-32 x 11/32 inch
-60	348-0050-00			2	GROMMET, plastic, 3/4 inch diameter
-61	385-0034-00			1	ROD, plastic, 5/16 dia x 3/4 inch long
	- - - - - -			-	mounting hardware: (not included w/rod)
	213-0041-00			1	SCREW, thread cutting, 6-32 x 3/8 inch, THS
-62	179-1056-00	100	2009	1	CABLE HARNESS, power
	179-1056-01	2010		1	CABLE HARNESS, power
-63	124-0145-00			12	STRIP, ceramic, 7/16 inch h, w/20 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0008-00			2	SPACER, plastic, 0.281 inch long
-64	214-0147-00			4	STRIP, ceramic, 7/16 inch h, w/4 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0008-00			2	SPACER, plastic, 0.281 inch long

FIG. 6 FAN MOTOR & HEAT SINK CHASSIS

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
6-1	147-0029-00			1	MOTOR, fan, 115 Volt
	- - - - - -			-	mounting hardware: (not included w/motor)
-2	211-0529-00			4	SCREW, 6-32 x 1$^{1}/_{4}$ inches, PHS
-3	210-0949-00			2	WASHER, flat, $^{9}/_{64}$ ID x $^{1}/_{2}$ OD, $^{1}/_{16}$ inch thick
-4	210-0457-00			4	NUT, keps, 6-32 x $^{5}/_{16}$ inch
-5	386-1006-00			1	PLATE, adapter, fan motor
	- - - - - -			-	mounting hardware: (not included w/plate)
	212-0010-00			4	SCREW, 8-32 x $^{5}/_{8}$ inch, PHS
-6	210-0458-00			3	NUT, keps, 8-32 x $^{11}/_{32}$ inch
-7	166-0098-00			1	TUBE, spacing, $^{3}/_{8}$ OD x $^{21}/_{32}$ inch long
-8	343-0002-00			1	CLAMP, cable, $^{3}/_{16}$ inch, plastic
	- - - - - -			-	mounting hardware: (not included w/clamp)
	210-0863-00			1	WASHER, D type
	212-0004-00			1	SCREW, 8-32 x $^{5}/_{16}$ inch, PHS
-9	426-0193-00			1	MOUNT, fan motor
	- - - - - -			-	mounting hardware: (not included w/mount)
-10	212-0004-00			4	SCREW, 8-32 x $^{5}/_{16}$ inch, PHS
-11	380-0088-00			1	HOUSING, fan & heat sink
	- - - - - -			-	mounting hardware: (not included w/housing)
-12	212-0004-00			4	SCREW, 8-32 x $^{5}/_{16}$ inch, PHS
-13	210-0457-00			4	NUT, keps, 6-32 x $^{5}/_{16}$ inch
-14	369-0022-00			1	FAN, blade
-15	348-0056-00			1	GROMMET, plastic, $^{3}/_{8}$ inch diameter
-16	348-0063-00			1	GROMMET, plastic, $^{1}/_{2}$ inch diameter
-17	214-0001-00			2	HINGE, 1$^{1}/_{2}$ x 1 inches
	- - - - - -			-	mounting hardware for each: (not included w/hinge)
-18	210-0457-00			2	NUT, keps, 6-32 x $^{5}/_{16}$ inch
-19	124-0088-00			1	STRIP, ceramic, $^{3}/_{4}$ inch h, w/4 notches
	- - - - - -			-	strip includes:
-20	355-0046-00			2	STUD, plastic
	- - - - - -			-	mounting hardware: (not included w/strip)
-21	361-0009-00			2	SPACER, plastic, 0.406 inch long
-22	407-0208-00			1	BRACKET, resistor mounting
	- - - - - -			-	mounting hardware: (not included w/bracket)
	210-0458-00			2	NUT, keps, 8-32 x $^{11}/_{32}$ inch

FIG. 6 FAN MOTOR & HEAT SINK CHASSIS (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
6-23	- - - - - -	100	829	3	RESISTOR
	- - - - - -	830		2	RESISTOR
	- - - - - -			-	mounting hardware for each: (not included w/resistor)
	211-0553-00			1	SCREW, 6-32 x $1\frac{1}{2}$ inches, RHS
	210-0601-00			1	EYELET, tapered barrel
	210-0478-00			1	NUT, hex., $\frac{5}{16}$ x $\frac{21}{32}$ inch long
	211-0507-00			1	SCREW, 6-32 x $\frac{5}{16}$ inch, PHS
-24	- - - - - -	100	829	6	RESISTOR
	- - - - - -	830		7	RESISTOR
	- - - - - -			-	mounting hardware for each: (not included w/resistor)
	212-0037-00			1	SCREW, 8-32 x $1\frac{3}{4}$ inches, PHS
	210-0809-00			1	WASHER, centering
	210-0462-00			1	NUT, hex., 8-32 x $\frac{1}{2}$ x $\frac{23}{64}$ inch
	212-0004-00			1	SCREW, 8-32 x $\frac{5}{16}$ inch, PHS
	210-0008-00			1	LOCKWASHER, internal, #8
-25	214-0641-02			2	HEAT SINK, middle
	- - - - - -			-	mounting hardware: (not included w/heat sink)
	210-0458-00			2	NUT, keps, 8-32 x $\frac{11}{32}$ inch
-26	- - - - - -			2	TRANSISTOR
	- - - - - -			-	mounting hardware for each: (not included w/transistor)
-27	211-0514-00			2	SCREW, 6-32 x $\frac{3}{4}$ inch, PHS
-28	386-0978-00			1	PLATE, mica, insulating
	214-0719-00			2	INSULATOR, bushing
	210-0803-00			2	WASHER, flat, 0.150 ID x $\frac{3}{8}$ inch OD
	210-0202-00			1	LUG, solder, SE #6
	210-0457-00			2	NUT, keps, 6-32 x $\frac{5}{16}$ inch
-29	214-0641-00			1	HEAT SINK, bottom
	- - - - - -			-	mounting hardware: (not included w/heat sink)
	210-0458-00			2	NUT, keps, 8-32 x $\frac{11}{32}$ inch
-30	- - - - - -			3	TRANSISTOR
	- - - - - -			-	mounting hardware for each: (not included w/transistor)
-31	211-0513-00			2	SCREW, 6-32 x $\frac{5}{8}$ inch, PHS
-32	386-0143-00			1	PLATE, mica, insulating
-33	214-0719-00			2	INSULATOR, bushing
-34	210-0803-00			2	WASHER, flat, 0.150 ID x $\frac{3}{8}$ inch OD
-35	210-0202-00			1	LUG, solder, SE #6
-36	210-0457-00			2	NUT, keps, 6-32 x $\frac{5}{16}$ inch
-37	214-0641-01			1	HEAT SINK, top
	- - - - - -			-	mounting hardware: (not included w/heat sink)
-38	210-0458-00			2	NUT, keps, 8-32 x $\frac{11}{32}$ inch

FIG. 6 FAN MOTOR & HEAT SINK CHASSIS *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
6-39	378-0768-00			1	SCREEN, filter
	- - - - - -			-	mounting hardware: (not included w/screen)
-40	211-0097-00			4	SCREW, 4-40 x 1/4 inch, PHS
-41	210-0851-00			4	WASHER, flat, 0.119 ID x 3/8 inch OD
-42	384-0616-00			4	ROD, spacer, hex., 1/4 x 1.380 inches long
-43	210-0004-00			4	LOCKWASHER, internal, #4
-44	179-1060-00	100	2009	1	CABLE HARNESS, heat sink
	179-1060-01	2010		1	CABLE HARNESS, heat sink
-45	386-1309-00	X2010		1	BRACKET, screen support
-46	- - - - - -			3	TRANSISTOR
	- - - - - -			-	mounting hardware for each: (not included w/transistor)
-47	211-0514-00	100	2009	2	SCREW, 6-32 x 3/4 inch, PHS
	211-0514-00	2010		1	SCREW, 6-32 x 3/4 inch, PHS
-48	211-0516-00	X2010		1	SCREW, 6-32 x 7/8 inch, PHS
-49	386-0978-00			1	PLATE, mica, insulating
	214-0719-00			2	INSULATOR, bushing
	210-0803-00			2	WASHER, flat, 0.0150 x 3/8 inch OD
	210-0202-00			1	LUG, solder, SE #6
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
-50	200-0692-00			1	COVER, transistor

FIG. 7 CRT SHIELD & REAR

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
7-1	337-0793-01			1	SHIELD, cathode ray tube
	- - - - - -			-	mounting hardware: (not included w/shield)
	211-0590-00			3	SCREW, 6-32 x $^1/_4$ inch, PHS
	407-0242-00			3	BRACKET, angle, CRT shield mounting
	210-0457-00			3	NUT, keps, 6-32 x $^5/_{16}$ inch
	211-0101-00			3	SCREW, 4-40 x $^1/_4$ inch, FHS
-2	354-0204-00			1	RING, plastic, CRT shockmount
-3	131-0435-00			1	ASSEMBLY, anode connector
	- - - - - -			-	assembly includes:
-4	200-0674-00			1	COVER, anode connector
-5	175-0012-00			ft.	CABLE, high voltage, insulated (specify 26 inch)
-6	131-0026-00			1	CLIP, anode connector
-7	- - - - - -			1	LINE FILTER
	- - - - - -			-	mounting hardware: (not included w/line filter)
-8	211-0071-00			2	SCREW, 4-40 x $^3/_8$ inch, THS
-9	386-1009-00	100	2009	1	PLATE, subpanel, rear
	386-1009-01	2010		1	PLATE, subpanel, rear
	- - - - - -			-	plate includes:
	354-0282-00			1	RING, ornamental
-10	260-0784-00			1	SWITCH, toggle—UPPER BEAM CHOPPED BLANKING
	- - - - - -			-	mounting hardware: (not included w/switch)
	354-0055-00			1	RING, switch locking, $^{15}/_{32}$ ID x $^{23}/_{32}$ inch OD
	210-0902-00			1	WASHER, flat, 0.470 ID x $^{21}/_{32}$ inch OD
	210-0473-00			1	NUT, 12 sided, $^{15}/_{32}$-32 x $^5/_{64}$ inch
-11	260-0784-00			1	SWITCH, toggle—LOWER BEAM CHOPPED BLANKING
	- - - - - -			-	mounting hardware: (not included w/switch)
	354-0055-00			1	RING, switch locking, $^{15}/_{32}$ ID x $^{23}/_{32}$ inch OD
-12	210-0902-00			1	WASHER, flat, 0.470 ID x $^{21}/_{32}$ inch OD
-13	210-0473-00			1	NUT, 12 sided, $^{15}/_{32}$-32 x $^5/_{64}$ inch
-14	386-1010-00	100	2009	1	PLATE, rear overlay
	386-1010-01	2010		1	PLATE, rear overlay
	- - - - - -			-	mounting hardware: (not included w/plate)
	213-0104-00	100	569	1	SCREW, thread forming, 6-32 x $^3/_8$ inch, THS
	213-0088-00	570		1	SCREW, thread forming, 4-40 x $^1/_4$ inch, PHS
-15	179-1072-00			1	CABLE HARNESS, CRT socket
	- - - - - -			-	cable harness includes:
	136-0240-00			1	ASSEMBLY, CRT socket
	- - - - - -			-	assembly includes:
-16	136-0202-01			1	SOCKET, CRT
	- - - - - -			-	socket includes:
	136-0202-00			1	SOCKET, CRT
	214-0464-00			14	PIN, CRT
-17	200-0616-00			1	COVER, CRT socket

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FIG. 7 CRT SHIELD & REAR *(cont)*

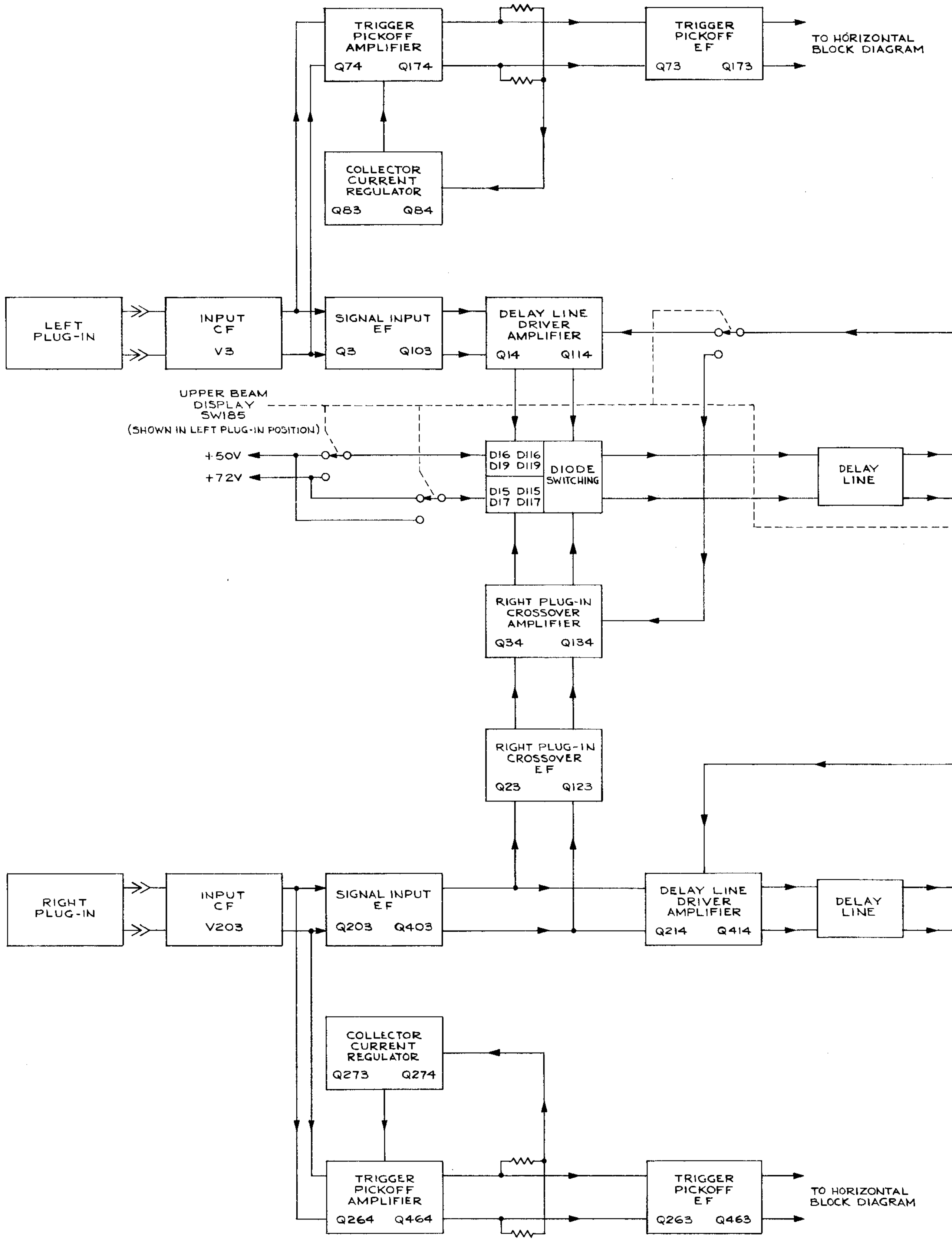
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
7-18	131-0150-00	100	839	1	CONNECTOR, 3 wire motor base
	131-0150-01	840		1	CONNECTOR, 3 wire motor base
	- - - - - -			-	connector includes:
	129-0041-00	100	839	1	POST, ground
	129-0041-01	840		1	POST, ground
	200-0185-00	100	839	1	COVER
	200-0185-01	840		1	COVER
	205-0014-00			1	SHELL, mounting
	210-0003-00	100	839X	2	LOCKWASHER, external, #4
	210-0551-00	100	839X	2	NUT, hex., 4-40 x 1/2 inch
	211-0132-00	X840		1	SCREW, sems, 4-40 x 1/2 inch, PHS
	211-0015-00	100	839	1	SCREW, 4-40 x 1/2 inch, PHS
	213-0088-00	840		1	SCREW, thread forming, 4-40 x 1/4 inch, PHS
	214-0078-00			2	PIN, connecting
	377-0041-00	100	839	1	INSERT
	377-0051-00	840		1	INSERT
	- - - - - -			-	mounting hardware: (not included w/connector)
-19	211-0542-00			2	SCREW, 6-32 x 5/16 inch, THS
-20	204-0279-00	X2010		1	BODY, voltaage selector
	- - - - - -			-	mounting hardware: (not included w/body)
-21	210-0407-00	X2010		2	NUT, hex., 6-32 x 1/4 inch
-22	200-0704-00	X2010		1	COVER, voltage selector
	- - - - - -			-	cover includes:
-23	352-0102-00	X2010		2	HOLDER, plastic, fuse
	- - - - - -			-	mounting hardware for each: (not included w/holder)
	213-0088-00	X2010		2	SCREW, thread forming, #4 x 1/4 inch, PHS
-24	214-0776-00	X2010		1	GASKET, RFI
	352-0002-00	100	2009X	2	ASSEMBLY, fuse holder (not shown)
	- - - - - -			-	each assembly includes:
	200-0582-00			1	CAP, fuse, black
	210-0873-00			1	WASHER, rubber, 1/2 ID x 11/16 inch OD
	352-0010-00			1	HOLDER, fuse
	NO NUMBER			1	NUT, hex., fuse holder
	200-0237-00	100	2009X	2	COVER, fuse holder (not shown)
-25	334-1034-00	100	2009X	1	TAG, Voltage, 115 Volt
-26	334-1035-00	100	2009X	1	TAG, Voltage, 230 Volt
	- - - - - -			-	mounting hardware for each: (not included w/tag)
	213-0104-00	100	2009X	2	SCREW, thread forming, 6-32 x 3/8 inch, THS
-27	131-0106-00			2	CONNECTOR, coaxial, contact, BNC
	- - - - - -			-	mounting hardware for each: (not included w/connector)
-28	210-0255-00			1	LUG, solder, 3/8 ID x 0.500 inch OD, SE
-29	200-0672-00			2	COVER, BNC w/chain
	- - - - - -			-	mounting hardware for each: (not included w/cover)
-30	213-0088-00			1	SCREW, thread forming, #4 x 1/4 inch, PHS
-31	343-0130-00			1	CLAMP, CRT
-32	343-0127-00			1	CLAMP, plastic, CRT
	- - - - - -			-	mounting hardware: (not included w/clamp)
-33	210-0866-00			4	WASHER, flat, 0.264 ID x 1 1/8 inches OD
-34	220-0416-00			4	NUT, wing, 10-32 inch

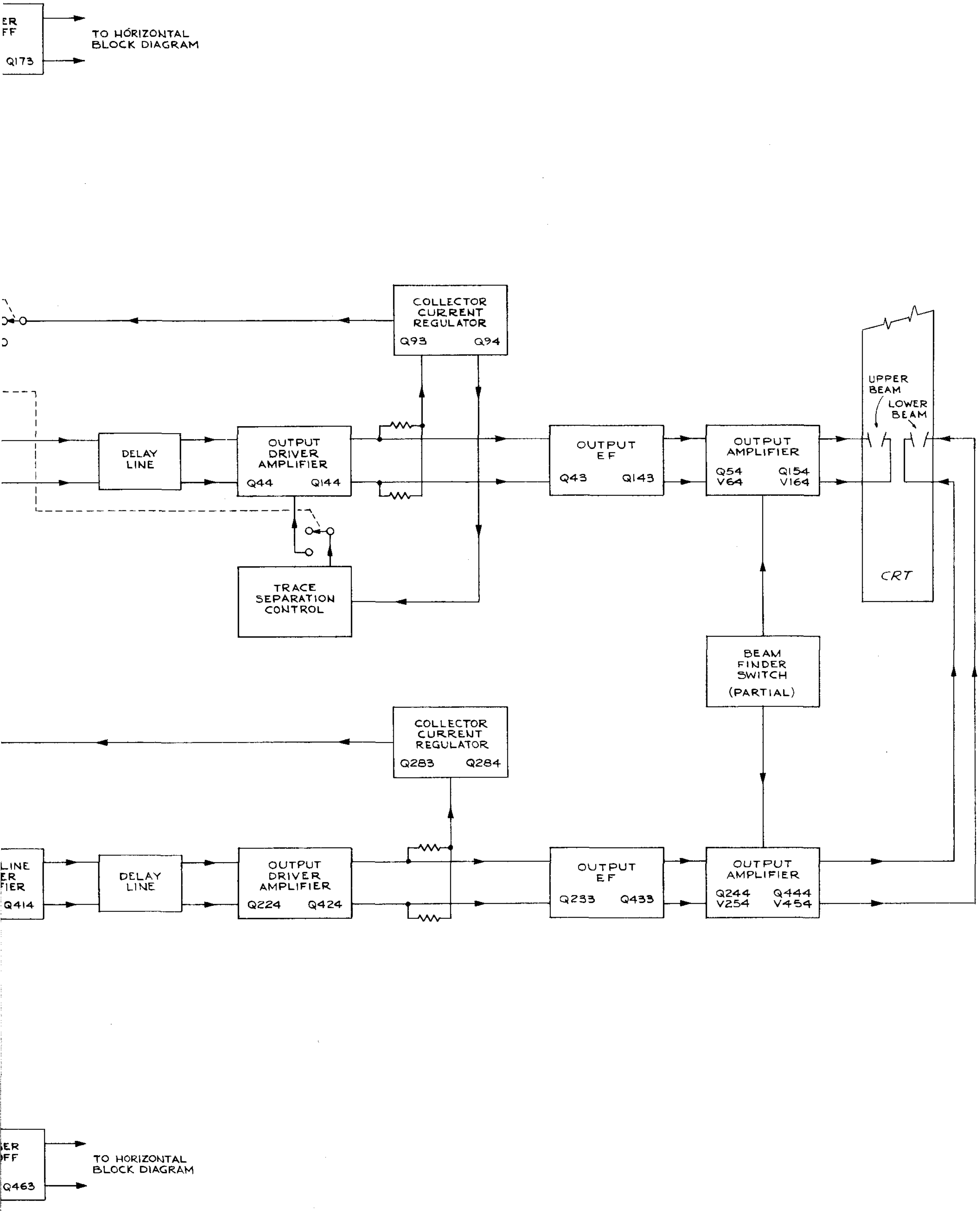
FIG. 7 CRT SHIELD & REAR *(cont)*

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
7-35	378-0034-01			1	FILTER, air, foam
-36	386-1012-00			1	PLATE, baffle, filter housing
	- - - - - -			-	mounting hardware: (not included w/plate)
	211-0542-00			2	SCREW, 6-32 x $^5/_{16}$ inch, THS
-37	380-0089-00	100	599	1	HOUSING, filter
	380-0089-01	600		1	HOUSING, filter
	- - - - - -			-	mounting hardware: (not included w/housing)
-38	212-0012-00			4	SCREW, 8-32 x 1$^1/_4$ inches, FHS
-39	210-0458-00			4	NUT, keps, 8-32 x $^{11}/_{32}$ inch
-40	210-0402-00			4	NUT, cap, hex., 8-32 x $^5/_{16}$ inch
-41	175-0588-00			1	WIRE, CRT lead, orange stripe
	175-0592-00			1	WIRE, CRT lead, green stripe
	175-0595-00			1	WIRE, CRT lead, red stripe
	175-0641-00			1	WIRE, CRT lead, brown stripe
	175-0642-00			1	WIRE, CRT lead, blue stripe
					each wire includes:
-42	131-0049-00			1	CONNECTOR, cable end, female

FIG. 8 CABINET & RAILS

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
8-1	386-1048-00			1	PLATE, cabinet, top
	- - - - - -			-	mounting hardware: (not included w/plate)
-2	212-0069-00			2	SCREW, 8-32 x 1/4 inch, THS
-3	211-0537-00			6	SCREW, 6-32 x 3/8 inch, THS
-4	386-1002-00			1	PLATE, cabinet, bottom
	- - - - - -			-	mounting hardware: (not included w/plate)
-5	212-0069-00			6	SCREW, 8-32 x 1/4 inch, THS
-6	386-1049-00			2	PLATE, cabinet, side, right & left
	- - - - - -			-	plate includes:
-7	214-0361-00			6	ASSEMBLY, cabinet latch
	- - - - - -			-	assembly includes:
-8	214-0400-00			1	PIN, securing, index
-9	358-0218-00			1	BUSHING, plastic, latch bearing
-10	387-0871-00			1	PLATE, latch index
-11	387-0804-00			1	PLATE, latch locking
-12	214-0359-00	100	1999	1	SPRING, latch
	220-0486-00	2000		1	NUT, push-on
-13	214-0734-00	100	599	8	SPRING, grounding
	214-0734-01	600		8	SPRING, grounding
-14	381-0248-00			2	ANGLE, frame, top, left & right
	- - - - - -			-	each angle includes:
-15	367-0037-00			1	HANDLE
	- - - - - -			-	handle includes:
-16	344-0098-00			2	CLIP, mounting
-17	212-0556-00			2	SCREW, 10-32 x 5/16 inch, RHS
	- - - - - -			-	mounting hardware for each: (not included w/angle)
-18	212-0038-00			4	SCREW, 8-32 x 3/8 inch, THS
-19	122-0135-00			2	RAIL, bottom, left or right
	- - - - - -			-	mounting hardware for each: (not included w/rail)
-20	212-0039-00			4	SCREW, 8-32 x 3/8 inch, THS
	212-0045-00			1	SCREW, 8-32 x 1/2 inch, THS
-21	348-0052-00			4	FOOT, anti slide
	- - - - - -			-	mounting hardware for each: (not included w/foot)
-22	212-0071-00			2	SCREW, 8-32 x 1 inch fil HS
-23	210-0458-00			2	NUT, keps, 8-32 x 11/32 inch

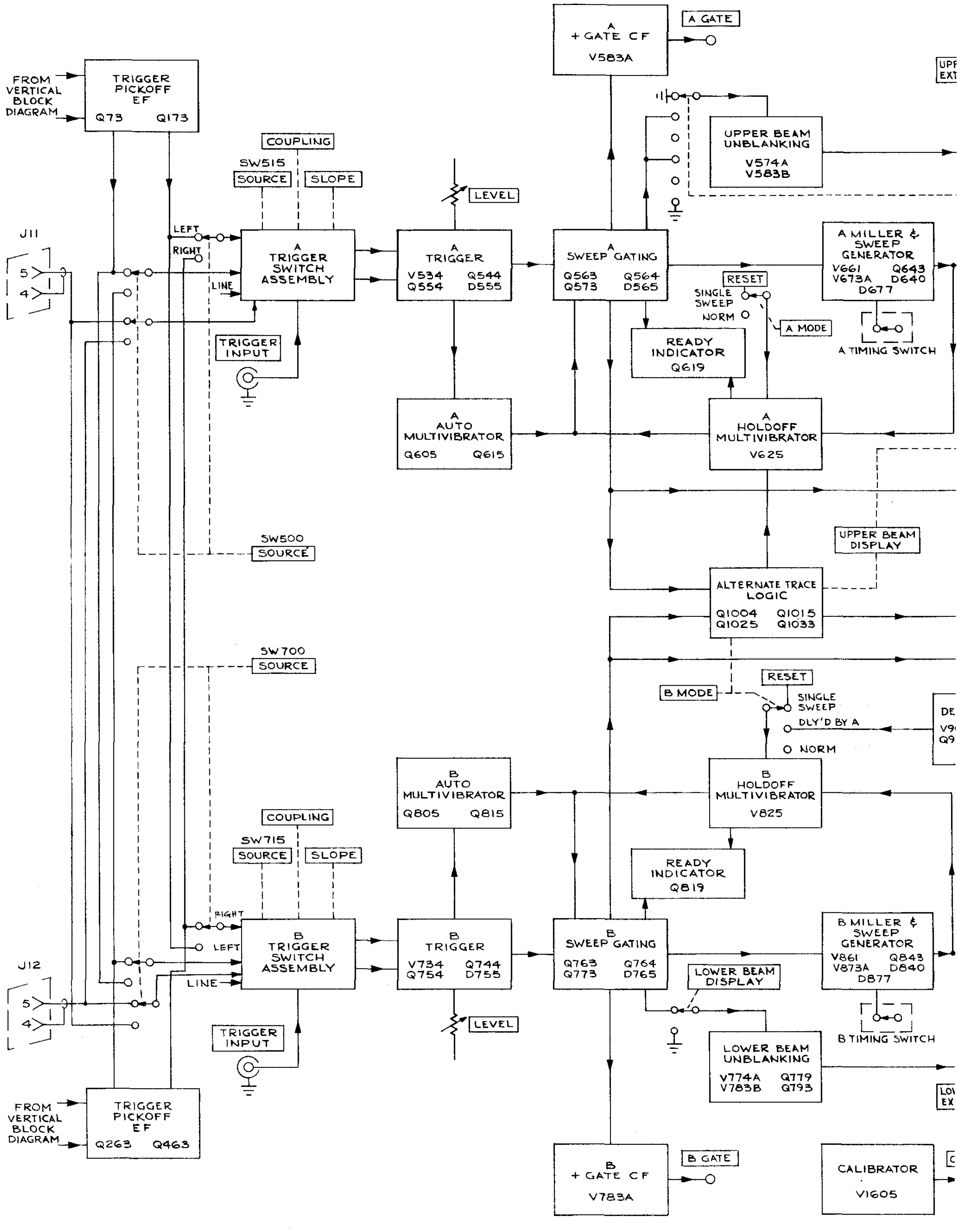

TRIGGER PICKOFF AMPLIFIER
Q74 Q174
TRIGGER PICKOFF EF
Q73 Q173
TO HORIZONTAL BLOCK DIAGRAM
COLLECTOR CURRENT REGULATOR
Q83 Q84
LEFT PLUG-IN
INPUT CF
V3
SIGNAL INPUT EF
Q3 Q103
DELAY LINE DRIVER AMPLIFIER
Q14 Q114
UPPER BEAM DISPLAY SW185
(SHOWN IN LEFT PLUG-IN POSITION)
+50V
+72V
D16 D116
D19 D119
D15 D115
D17 D117
DIODE SWITCHING
DELAY LINE
RIGHT PLUG-IN CROSSOVER AMPLIFIER
Q34 Q134
RIGHT PLUG-IN CROSSOVER EF
Q23 Q123
RIGHT PLUG-IN
INPUT CF
V203
SIGNAL INPUT EF
Q203 Q403
DELAY LINE DRIVER AMPLIFIER
Q214 Q414
DELAY LINE
COLLECTOR CURRENT REGULATOR
Q273 Q274
TRIGGER PICKOFF AMPLIFIER
Q264 Q464
TRIGGER PICKOFF EF
Q263 Q463
TO HORIZONTAL BLOCK DIAGRAM

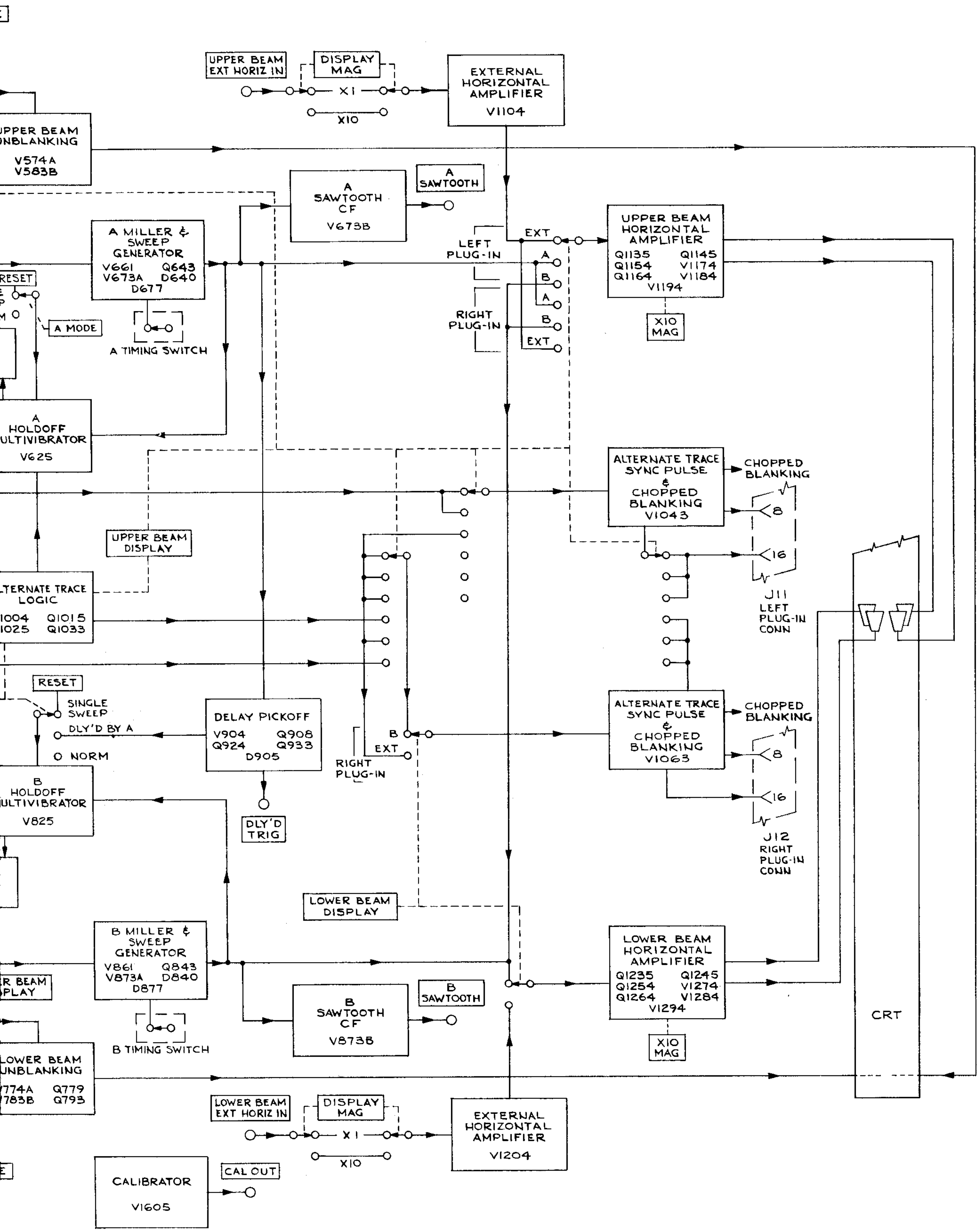


MRH
666

B

VERTICAL BLOCK DIAGRAM

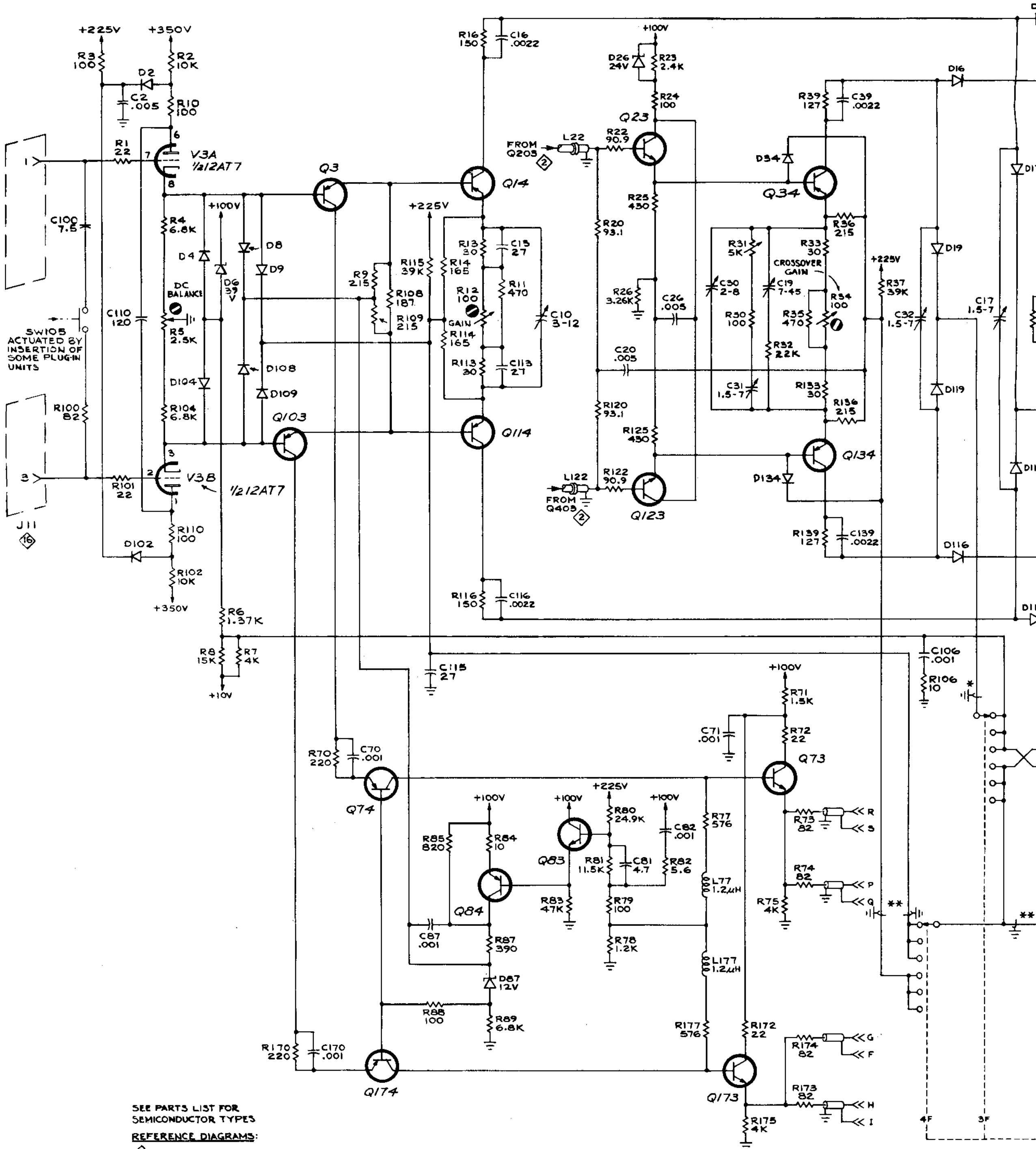

FROM VERTICAL BLOCK DIAGRAM
TRIGGER PICKOFF EF
Q73 Q173
COUPLING
SW515
SOURCE
SLOPE
J11
LEFT
RIGHT
LINE
A TRIGGER SWITCH ASSEMBLY
TRIGGER INPUT
LEVEL
A TRIGGER
V534 Q544
Q554 D555
A + GATE CF
V583A
A GATE
A SWEEP GATING
Q563 Q564
Q573 D565
UPPER BEAM UNBLANKING
V574A
V583B
RESET
SINGLE SWEEP
NORM
A MODE
READY INDICATOR
Q619
A MILLER & SWEEP GENERATOR
V661 Q643
V673A D640
D677
A TIMING SWITCH
A AUTO MULTIVIBRATOR
Q605 Q615
A HOLDOFF MULTIVIBRATOR
V625
SW500
SOURCE
UPPER BEAM DISPLAY
ALTERNATE TRACE LOGIC
Q1004 Q1015
Q1025 Q1033
SW700
SOURCE
B MODE
RESET
SINGLE SWEEP
DLY'D BY A
NORM
B AUTO MULTIVIBRATOR
Q805 Q815
B HOLDOFF MULTIVIBRATOR
V825
COUPLING
SW715
SOURCE
SLOPE
READY INDICATOR
Q819
RIGHT
LEFT
J12
LINE
B TRIGGER SWITCH ASSEMBLY
B TRIGGER
V734 Q744
Q754 D755
B SWEEP GATING
Q763 Q764
Q773 D765
LOWER BEAM DISPLAY
B MILLER & SWEEP GENERATOR
V861 Q843
V873A D840
D877
B TIMING SWITCH
LEVEL
TRIGGER INPUT
LOWER BEAM UNBLANKING
V774A Q779
V783B Q793
FROM VERTICAL BLOCK DIAGRAM
TRIGGER PICKOFF EF
Q263 Q463
B + GATE CF
V783A
B GATE
CALIBRATOR
V1605



MRH
666

B

HORIZONTAL BLOCK DIAGRAM



SEE PARTS LIST FOR SEMICONDUCTOR TYPES

REFERENCE DIAGRAMS:

(2) RIGHT VERTICAL AMPLIFIER

(3) A SWEEP TRIGGER

(6) B SWEEP TRIGGER

(14) POWER SUPPLY

(16) PLUG-IN JACK DETAILS

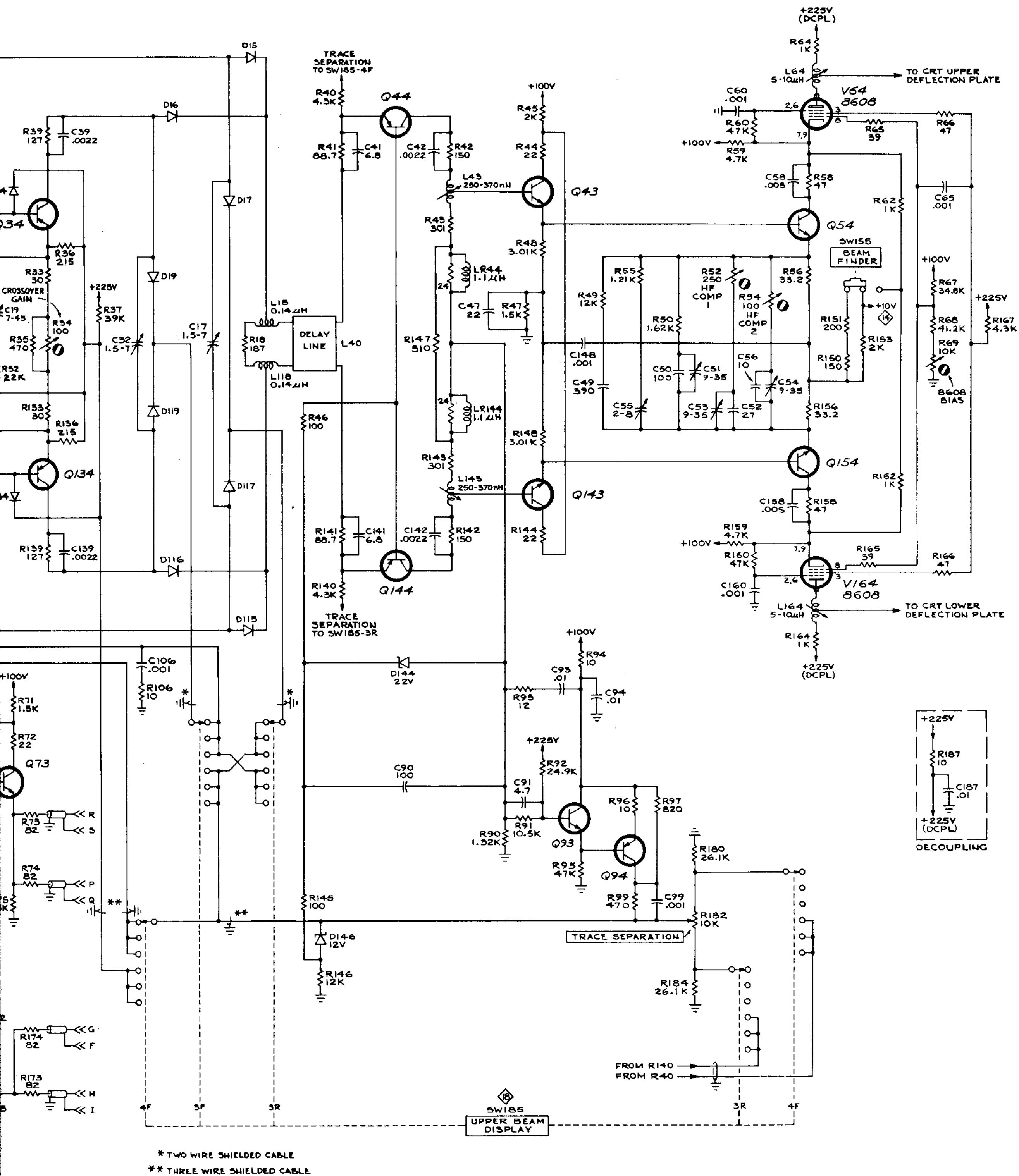
(18) HORIZONTAL DISPLAY & MODE SWITCHING

* TWO WIRE SHIELD

** THREE WIRE SHIE

TYPE 556 OSCILLOSCOPE

A



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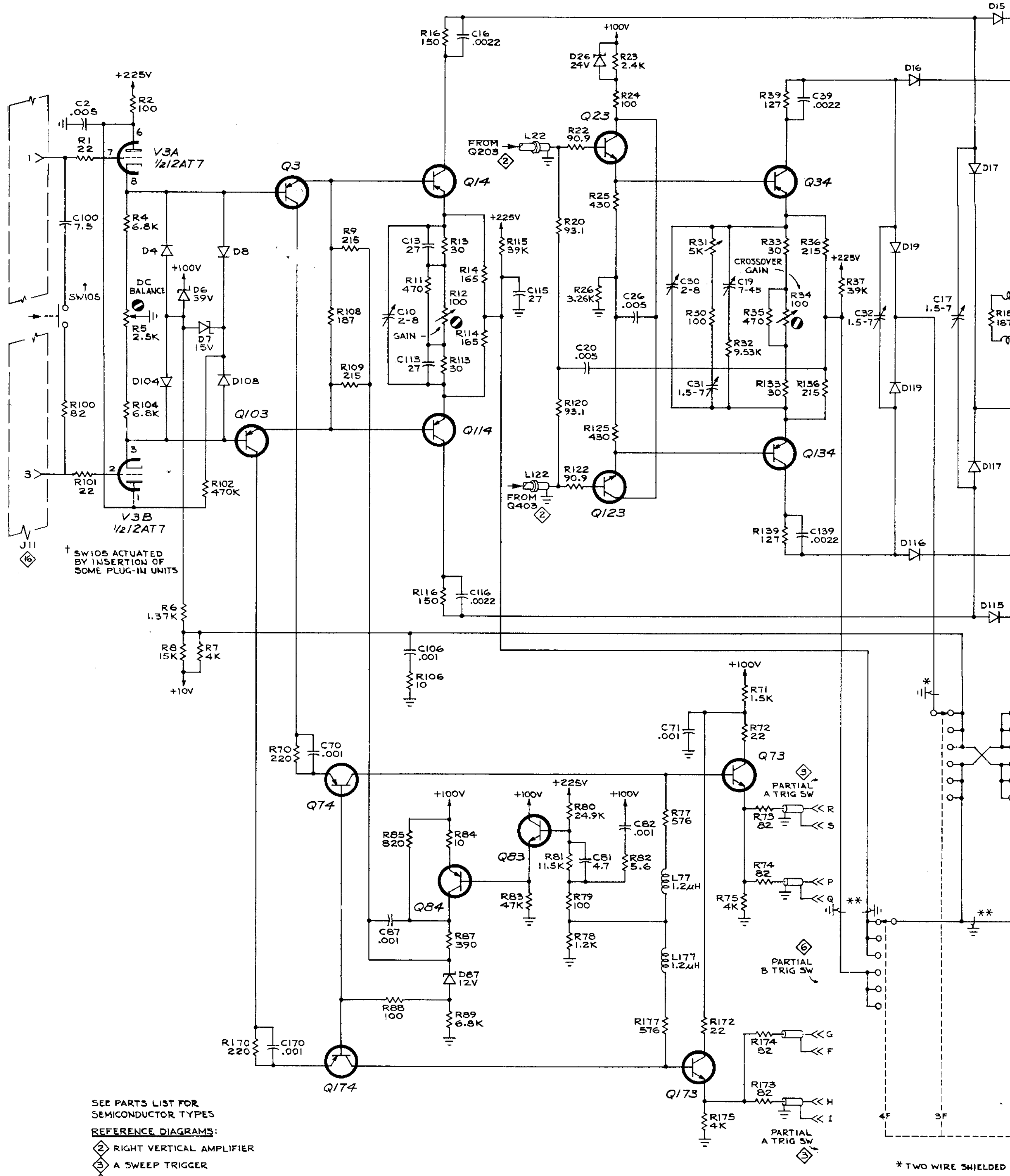
867

LEFT VERTICAL AMPLIFIER ①

S/N 2000 - UP

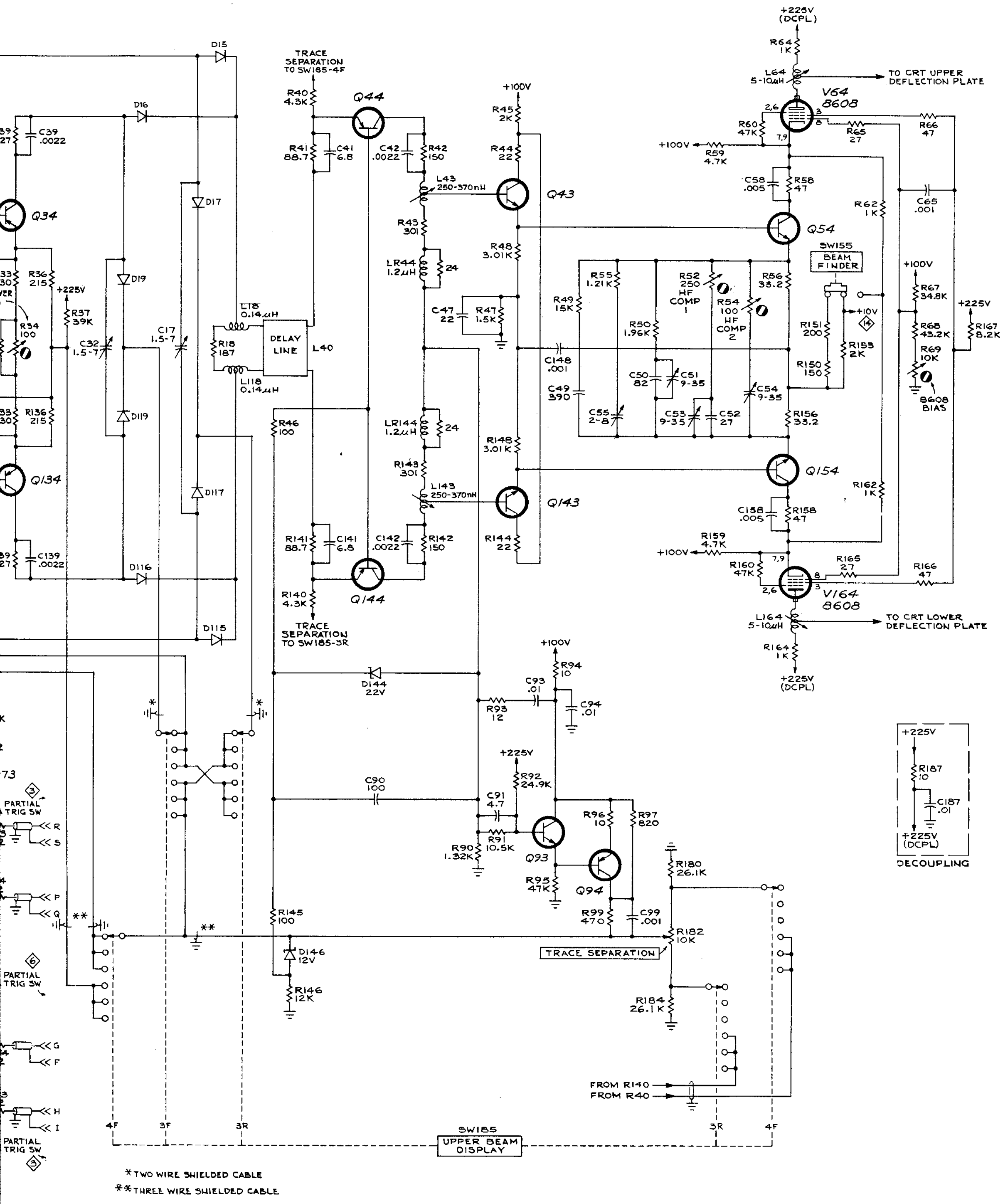
A



SEE PARTS LIST FOR SEMICONDUCTOR TYPES

REFERENCE DIAGRAMS:

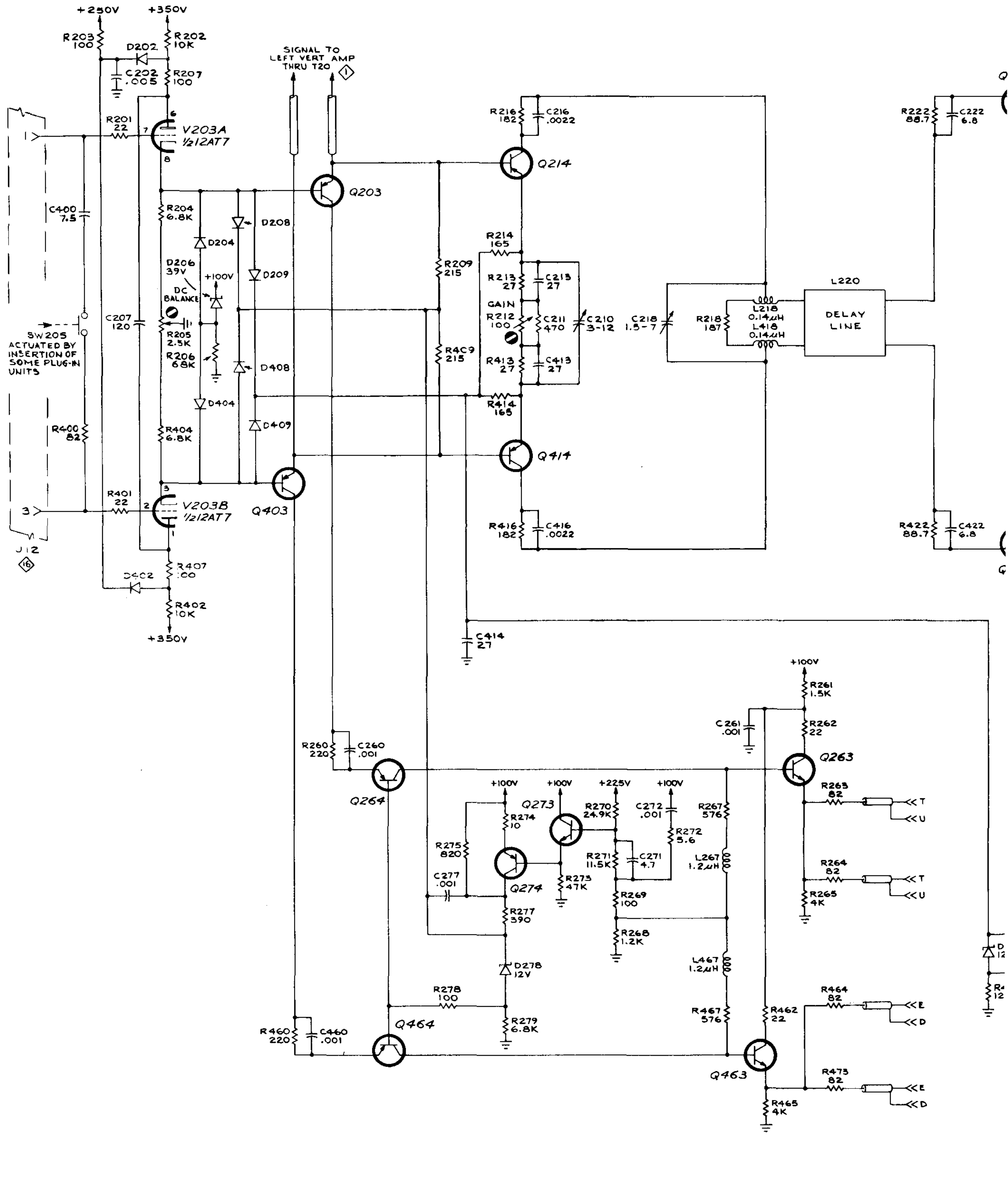
- ② RIGHT VERTICAL AMPLIFIER
- ③ A SWEEP TRIGGER
- ⑥ B SWEEP TRIGGER
- ⑭ POWER SUPPLY
- ⑯ PLUG-IN JACK DETAILS



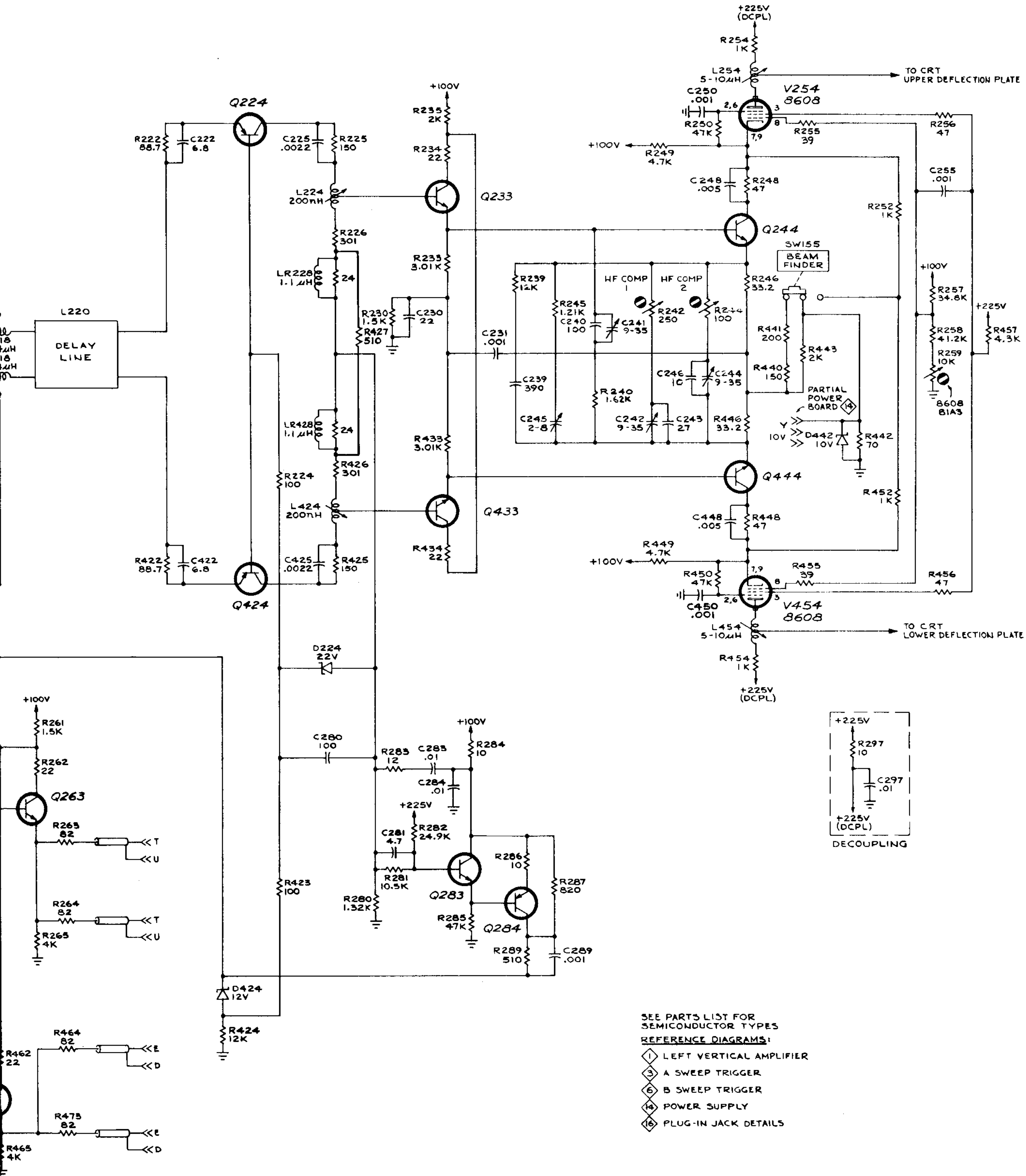
MRH
966

LEFT VERTICAL AMPLIFIER ①

S/N 100-1999


+250V
+350V
R203 100
D202
R202 10K
C202 .005
R207 100
SIGNAL TO LEFT VERT AMP THRU T20
R201 22
V203A 1/2 12AT7
Q203
Q214
R216 182
C216 .0022
R204 6.8K
D204
D208
D209
D206 39V
+100V
DC BALANCE
R205 2.5K
R206 68K
C207 120
C400 7.5
SW205 ACTUATED BY INSERTION OF SOME PLUG-IN UNITS
R400 82
D404
D408
D409
R404 6.8K
R209 215
R409 215
R214 165
R213 27
C213 27
GAIN
R212 100
C211 470
C210 3-12
R413 27
C413 27
R414 165
C218 1.5-7
R218 187
L218 0.14μH
L418 0.14μH
L220
DELAY LINE
R222 88.7
C222 6.8
Q414
Q403
R401 22
V203B 1/2 12AT7
R416 182
C416 .0022
R422 88.7
C422 6.8
J12
D402
R407 100
R402 10K
+350V
C414 27
+100V
R261 1.5K
C261 .001
R262 22
R260 220
C260 .001
Q264
Q263
+100V
+100V
+225V
+100V
Q273
R274 10
R270 24.9K
C272 .001
R272 5.6
R267 576
R265 82
R275 820
R271 11.5K
C271 4.7
L267 1.2μH
R264 82
C277 .001
Q274
R273 47K
R269 100
R265 4K
R277 390
R268 1.2K
D278 12V
L467 1.2μH
R278 100
R464 82
R460 220
C460 .001
Q464
R279 6.8K
R467 576
R462 22
Q463
R475 82
R465 4K

A



SEE PARTS LIST FOR SEMICONDUCTOR TYPES

REFERENCE DIAGRAMS:

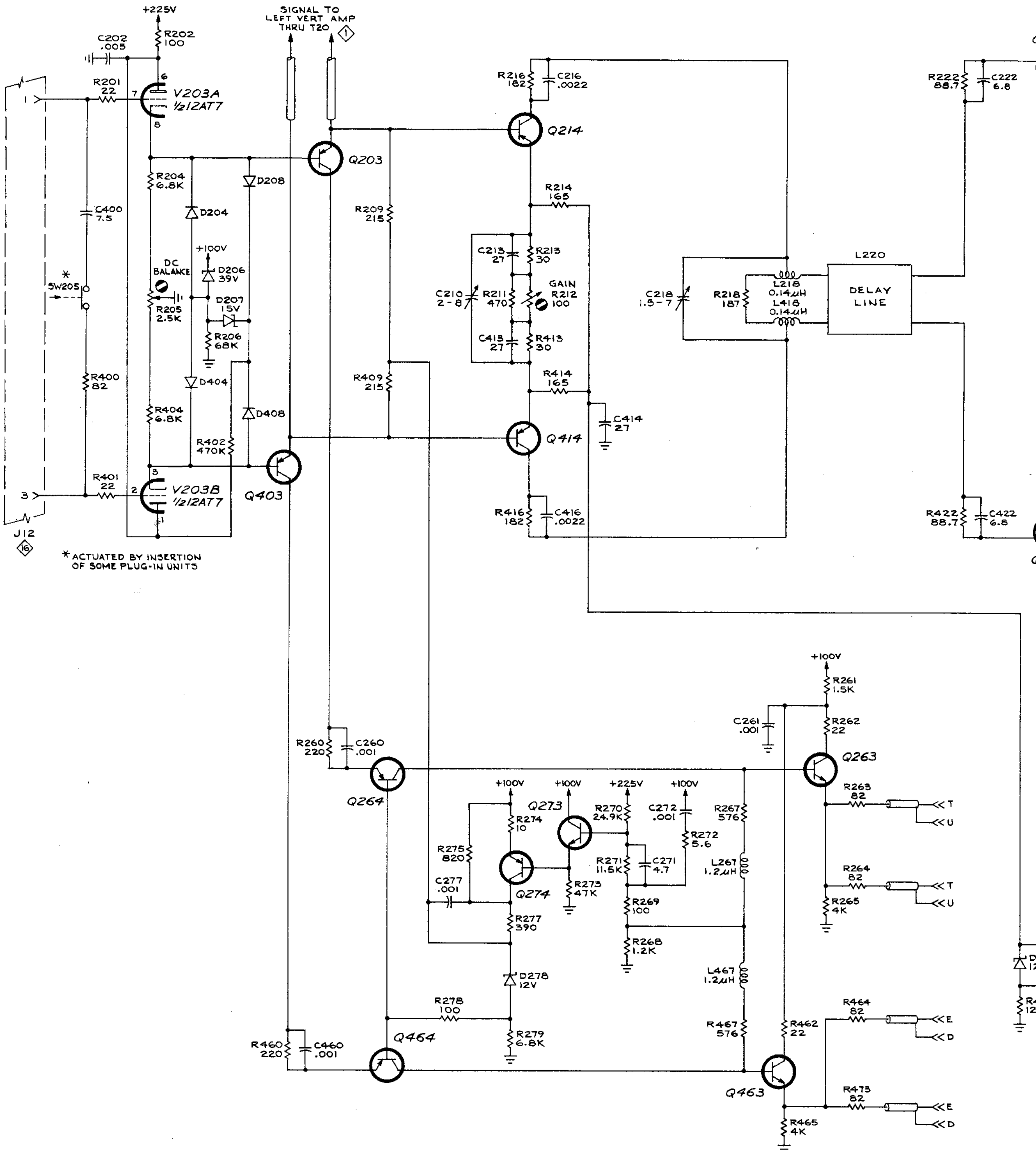
- ① LEFT VERTICAL AMPLIFIER
- ③ A SWEEP TRIGGER
- ⑥ B SWEEP TRIGGER
- ⑭ POWER SUPPLY
- ⑯ PLUG-IN JACK DETAILS

A

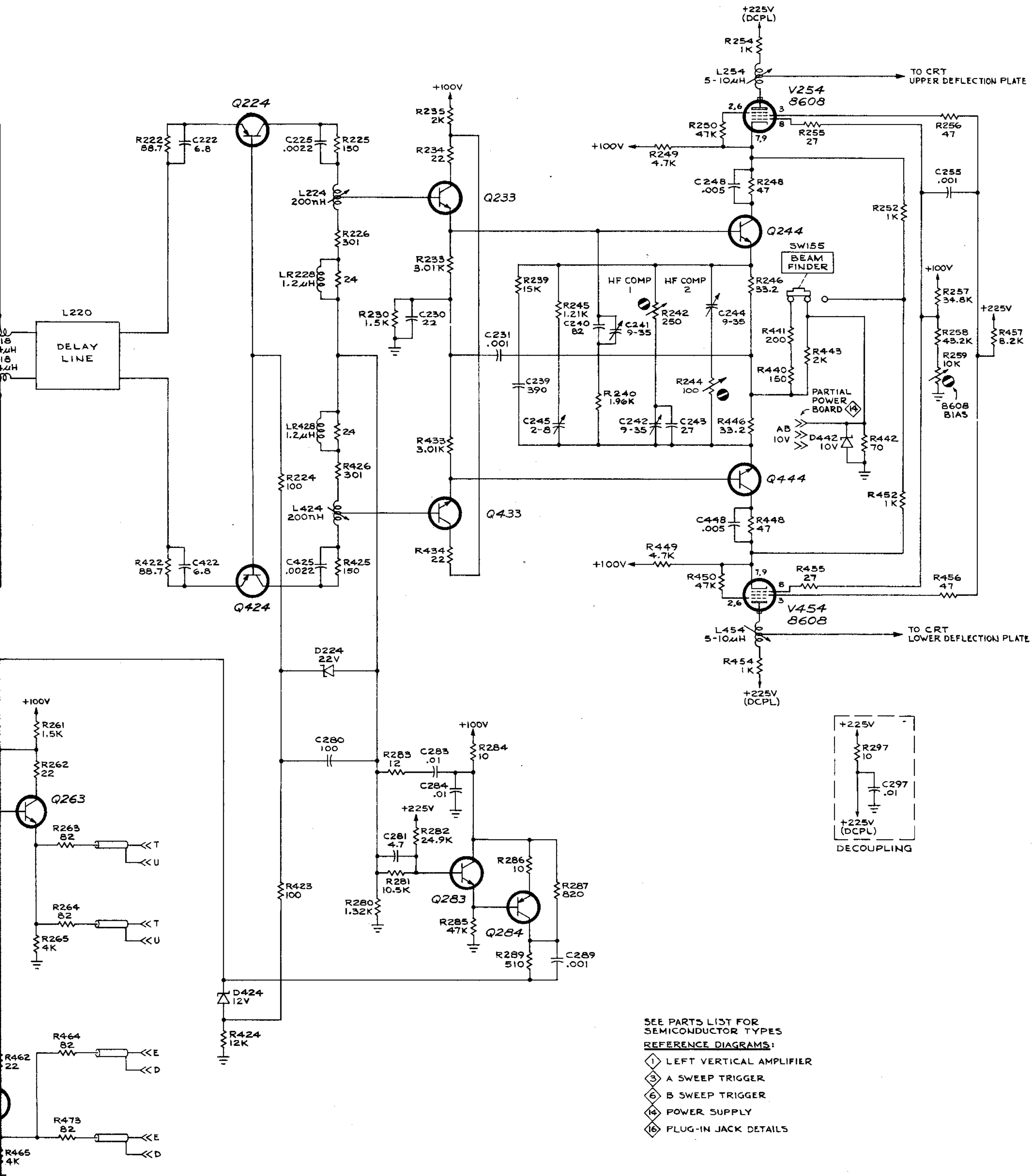
MRH 867

RIGHT VERTICAL AMPLIFIER ②

S/N 2000 - UP


+225V
R202
100
C202
.005
SIGNAL TO
LEFT VERT AMP
THRU T20
R201
22
V203A
½12AT7
Q203
Q214
R216
182
C216
.0022
R222
88.7
C222
6.8
D208
R204
6.8K
D204
C400
7.5
R209
215
R214
165
+100V
D206
39V
DC
BALANCE
R205
2.5K
D207
15V
R206
68K
SW205
C213
27
R213
30
C210
2-8
R211
470
GAIN
R212
100
C413
27
R413
30
C218
1.5-7
R218
187
L218
0.14μH
L418
0.14μH
L220
DELAY
LINE
R400
82
D404
D408
R409
215
R414
165
C414
27
R404
6.8K
R402
470K
Q414
Q403
R401
22
V203B
½12AT7
R416
182
C416
.0022
R422
88.7
C422
6.8
J12
*ACTUATED BY INSERTION
OF SOME PLUG-IN UNITS
+100V
R261
1.5K
C261
.001
R262
22
R260
220
C260
.001
Q263
Q264
R263
82
+100V
+100V
+225V
+100V
Q273
R270
24.9K
C272
.001
R267
576
R274
10
R272
5.6
R275
820
R271
11.5K
C271
4.7
L267
1.2μH
R264
82
C277
.001
Q274
R273
47K
R269
100
R265
4K
R277
390
R268
1.2K
D278
12V
L467
1.2μH
R278
100
R464
82
R467
576
R462
22
Q464
R279
6.8K
R460
220
C460
.001
Q463
R473
82
R465
4K

C



SEE PARTS LIST FOR SEMICONDUCTOR TYPES

REFERENCE DIAGRAMS:

1. LEFT VERTICAL AMPLIFIER
3. A SWEEP TRIGGER
6. B SWEEP TRIGGER
14. POWER SUPPLY
16. PLUG-IN JACK DETAILS

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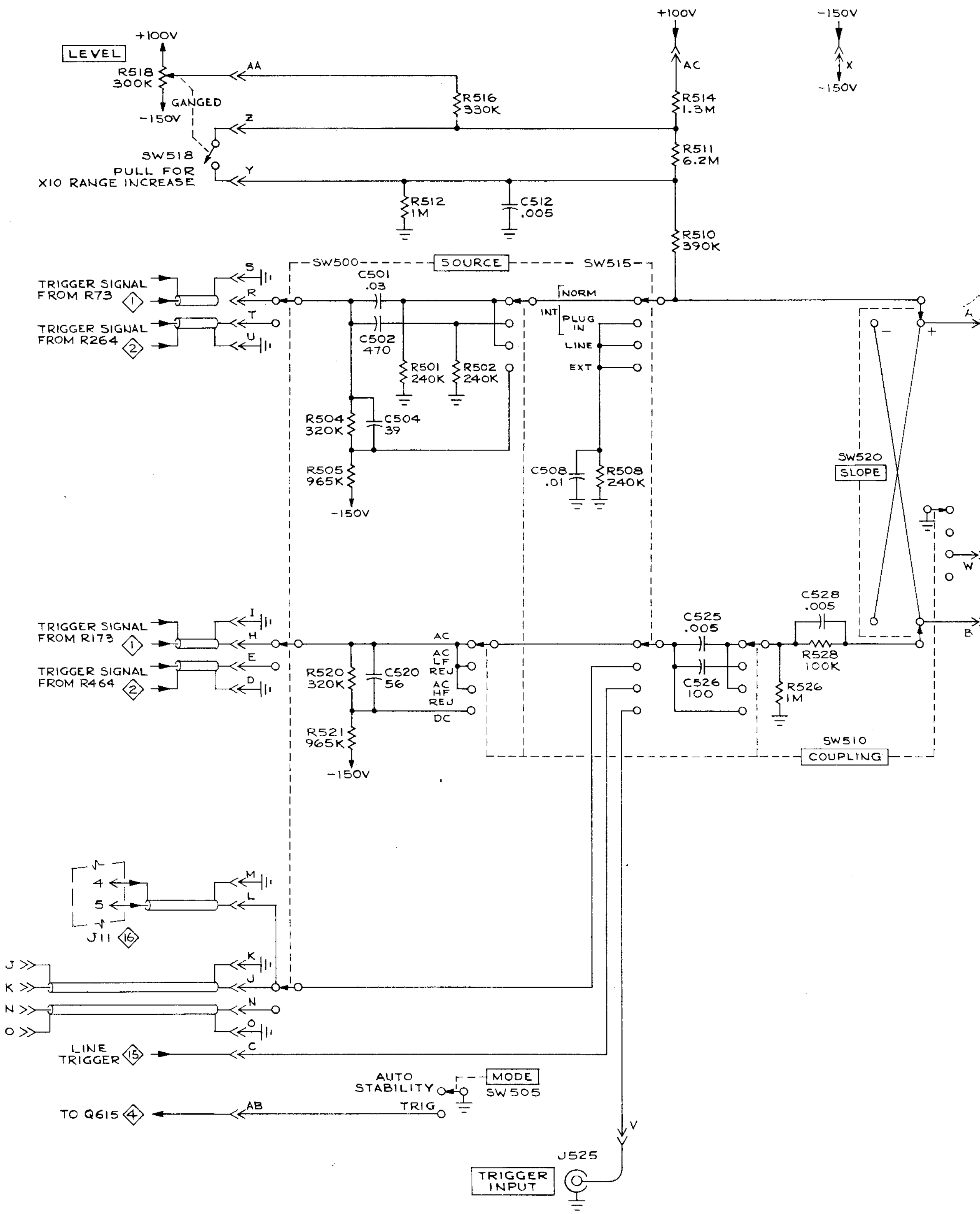
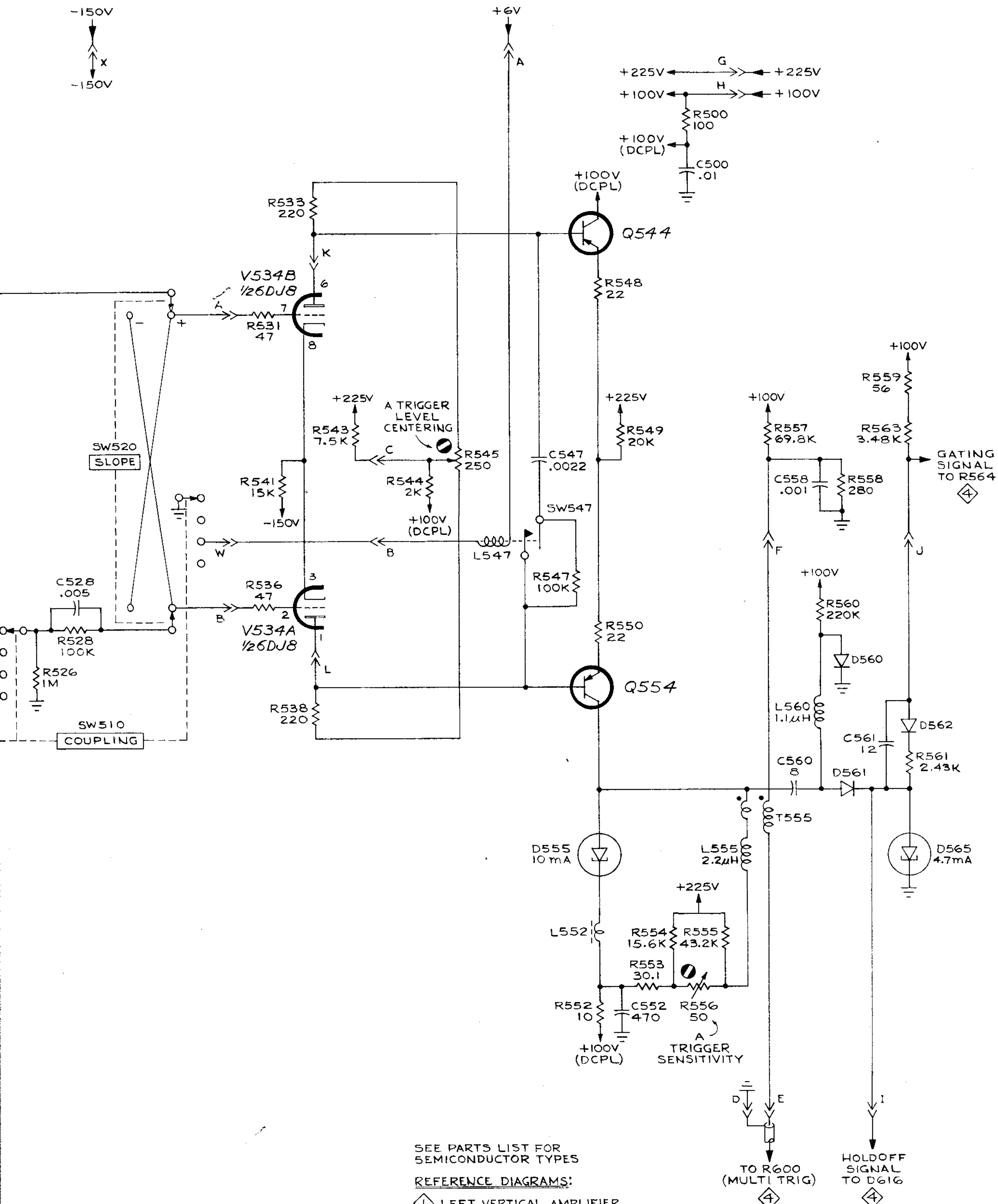
966

RIGHT VERTICAL AMPLIFIER ②

S/N 100-1999


LEVEL
R518
300K
+100V
-150V
GANGED
SW518
PULL FOR
X10 RANGE INCREASE
R516
330K
R512
1M
C512
.005
+100V
AC
R514
1.3M
R511
6.2M
R510
390K
-150V
X
-150V
SW500
SOURCE
SW515
TRIGGER SIGNAL
FROM R73
TRIGGER SIGNAL
FROM R264
C501
.03
C502
470
R501
240K
R502
240K
R504
320K
C504
39
R505
965K
-150V
NORM
INT
PLUG IN
LINE
EXT
C508
.01
R508
240K
SW520
SLOPE
TRIGGER SIGNAL
FROM R173
TRIGGER SIGNAL
FROM R464
R520
320K
C520
56
R521
965K
-150V
AC
AC LF REJ
AC HF REJ
DC
C525
.005
C526
100
C528
.005
R528
100K
R526
1M
SW510
COUPLING
J11
LINE
TRIGGER
AUTO
STABILITY
TRIG
MODE
SW505
TO Q615
J525
TRIGGER
INPUT



SEE PARTS LIST FOR SEMICONDUCTOR TYPES

REFERENCE DIAGRAMS:

1 LEFT VERTICAL AMPLIFIER
2 RIGHT VERTICAL AMPLIFIER
4 A SWEEP GENERATOR
6 B SWEEP TRIGGER
15 HEATER WIRING
16 PLUG-IN JACK DETAILS

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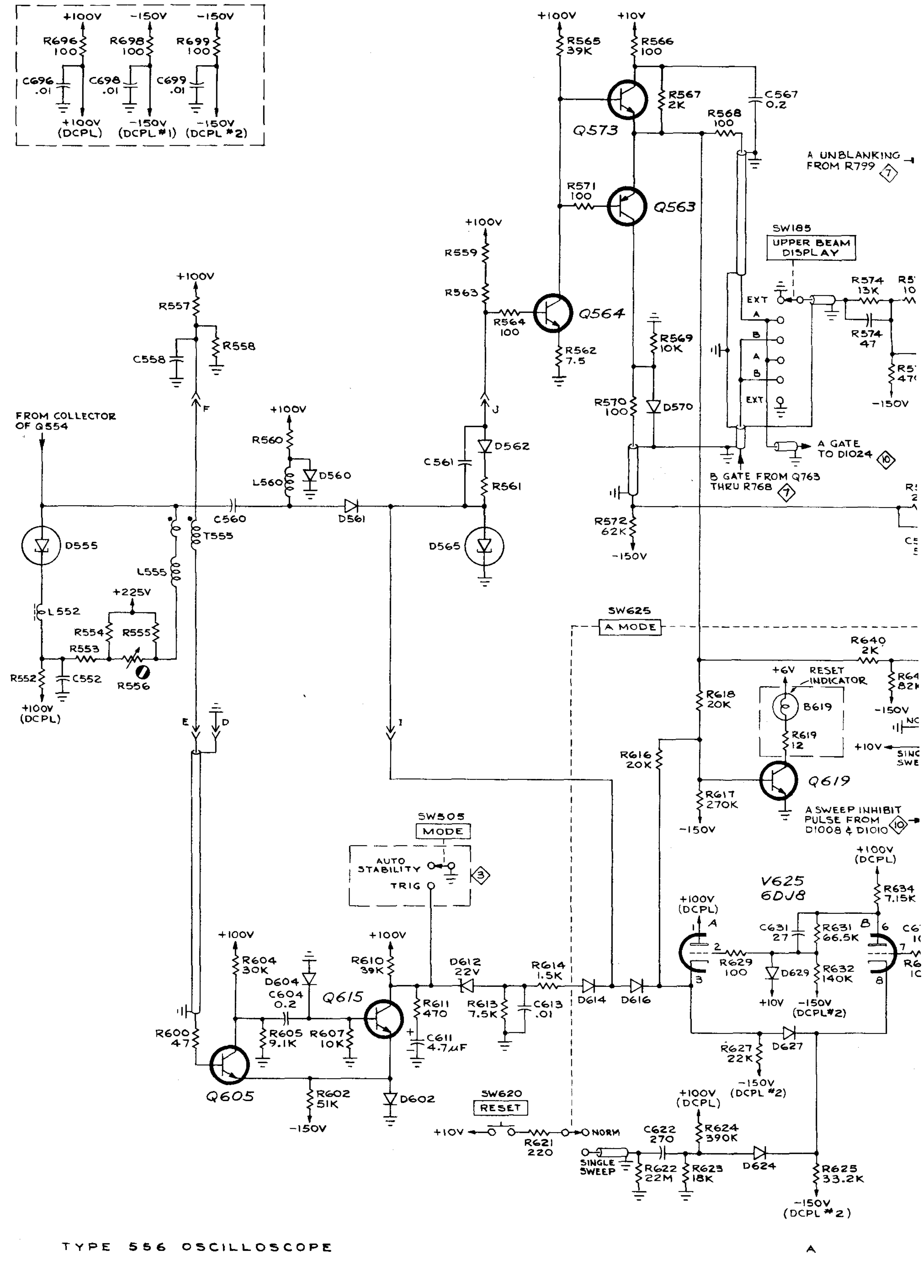
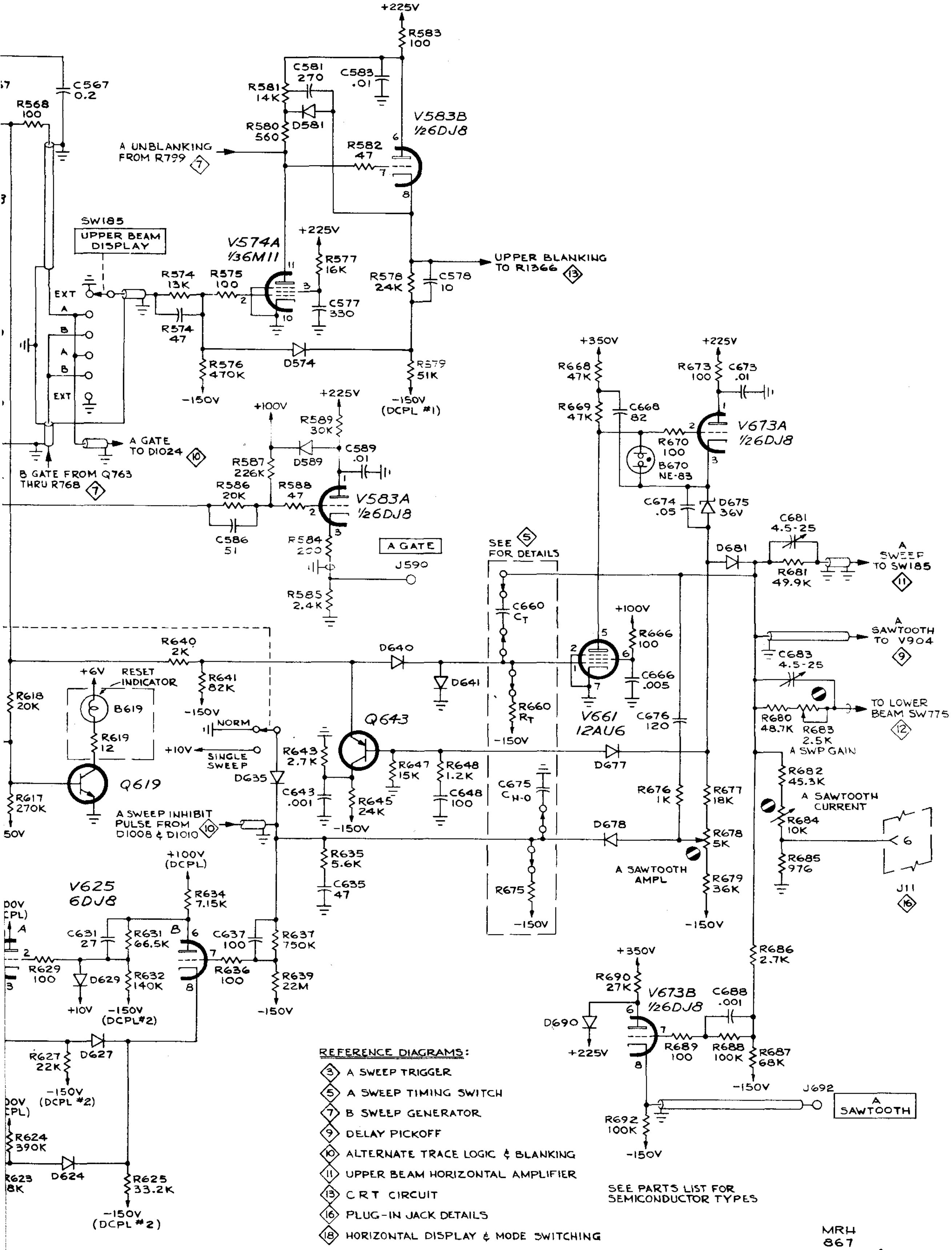
666

A SWEEP TRIGGER 3

B

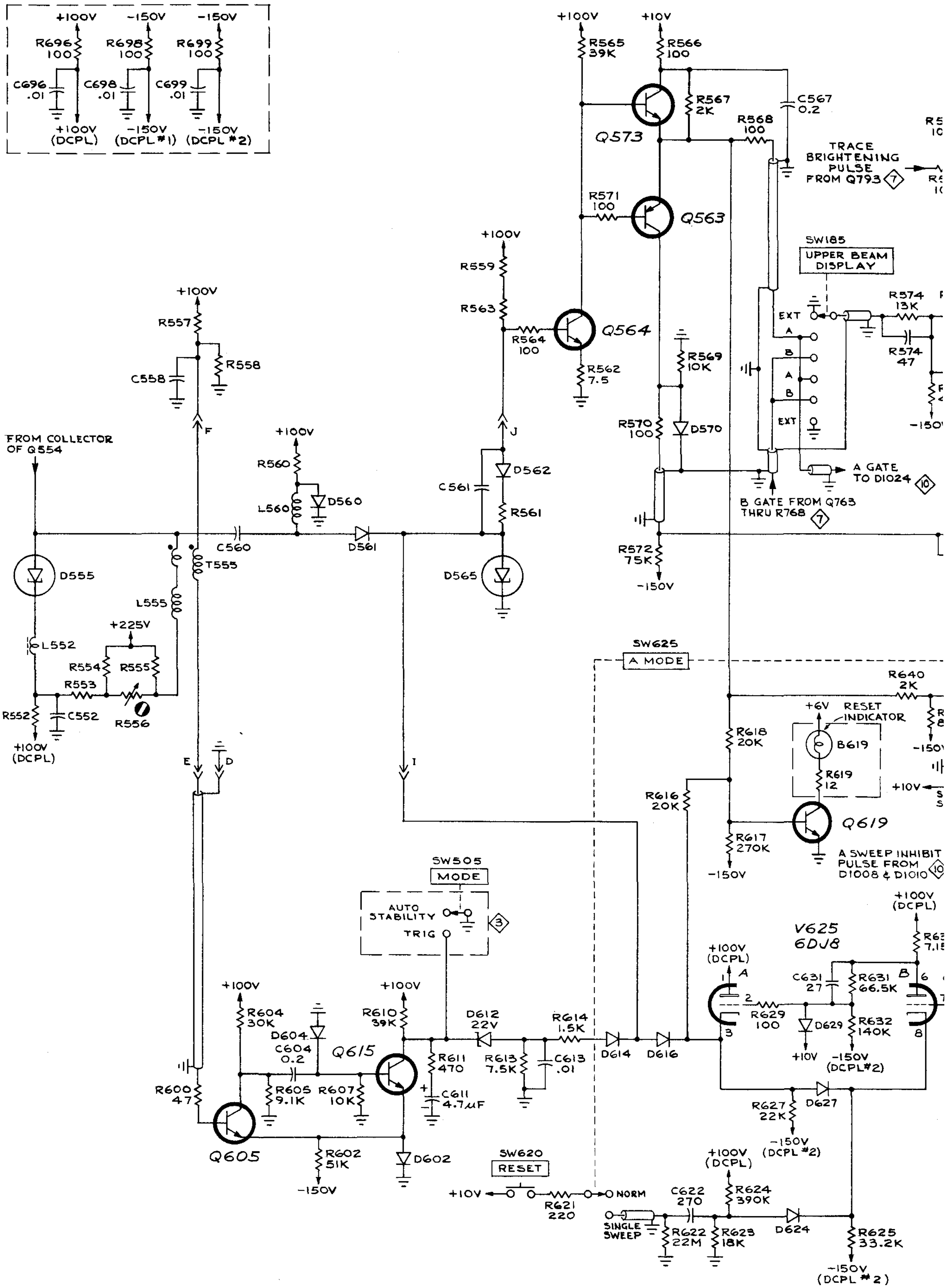

+100V
-150V
R696 100
R698 100
R699 100
C696 .01
C698 .01
C699 .01
+100V (DCPL)
-150V (DCPL #1)
-150V (DCPL #2)
+10V
R565 39K
R566 100
R567 2K
C567 0.2
R568 100
Q573
Q563
R571 100
A UNBLANKING FROM R799 7
SW185 UPPER BEAM DISPLAY
R559
R563
R564 100
Q564
R562 7.5
R569 10K
R570 100
D570
R572 62K
R574 13K
R574 47
EXT
A
B
A GATE TO D1024 10
B GATE FROM Q763 THRU R768 7
R557
R558
C558
FROM COLLECTOR OF Q554
R560
L560
D560
C561
D562
R561
C560
D561
D555
T555
L555
D565
L552
+225V
R554
R555
R553
R556
R552
C552
+100V (DCPL)
SW625 A MODE
R640 2K
+6V
RESET INDICATOR
B619
R618 20K
R619 12
R616 20K
Q619
R617 270K
A SWEEP INHIBIT PULSE FROM D1008 & D1010 10
SW505 MODE
AUTO STABILITY
TRIG
3
V625 6DJ8
R634 7.15K
C631 27
R631 66.5K
R629 100
D629
R632 140K
R604 30K
D604
C604 0.2
Q615
R610 39K
D612 22V
R614 1.5K
D614
D616
R611 470
R613 7.5K
C613 .01
R605 9.1K
R607 10K
C611 4.7µF
R600 47
Q605
R602 51K
D602
R627 22K
D627
SW620 RESET
R621 220
NORM
C622 270
R624 390K
SINGLE SWEEP
R622 22M
R623 18K
D624
R625 33.2K

A

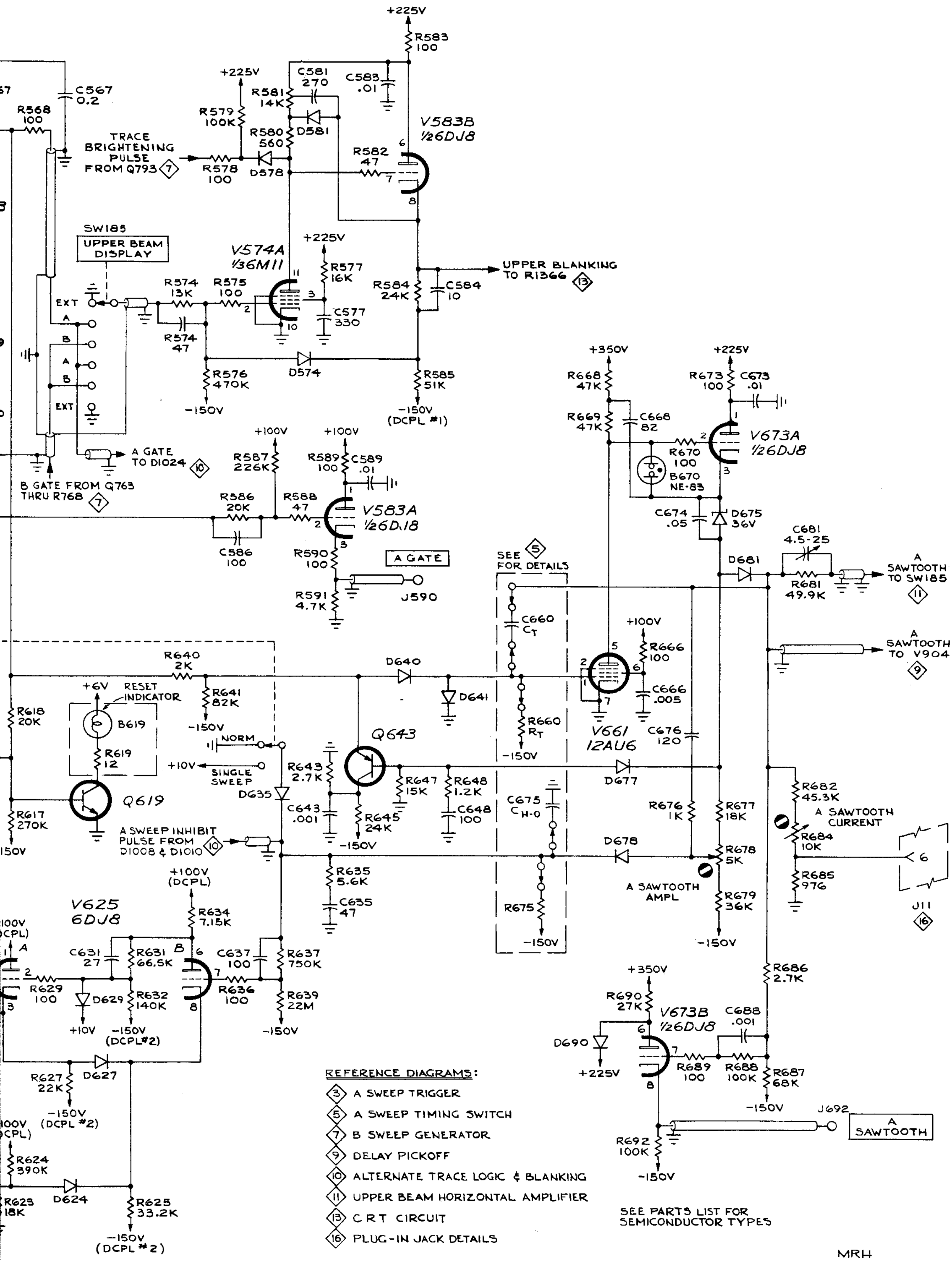


A SWEEP GENERATOR 4

S/N 2000-UP


+100V
-150V
R696 100
R698 100
R699 100
C696 .01
C698 .01
C699 .01
+100V (DCPL)
-150V (DCPL #1)
-150V (DCPL #2)
+10V
R565 39K
R566 100
R567 2K
C567 0.2
R568 100
Q573
TRACE BRIGHTENING PULSE FROM Q793
R571 100
Q563
SW185
UPPER BEAM DISPLAY
R559
R563
R564 100
Q564
R562 7.5
R569 10K
R570 100
D570
R574 13K
R574 47
EXT
A
B
A GATE TO D1024
B GATE FROM Q763 THRU R768
R572 75K
R557
R558
C558
FROM COLLECTOR OF Q554
R560
L560
D560
C560
D561
C561
D562
R561
D565
D555
T555
L555
L552
+225V
R554
R555
R553
R556
R552
C552
+100V (DCPL)
SW625
A MODE
R640 2K
+6V
RESET INDICATOR
B619
R618 20K
R619 12
R616 20K
Q619
R617 270K
A SWEEP INHIBIT PULSE FROM D1008 & D1010
SW505
MODE
AUTO STABILITY
TRIG
V625 6DJ8
C631 27
R631 66.5K
R629 100
D629
R632 140K
R604 30K
D604
C604 0.2
Q615
R610 39K
D612 22V
R614 1.5K
R611 470
R613 7.5K
C613 .01
D614
D616
R600 47
R605 9.1K
R607 10K
C611 4.7μF
Q605
R602 51K
D602
SW620
RESET
R621 220
NORM
SINGLE SWEEP
C622 270
R624 390K
R622 22M
R623 18K
D624
R627 22K
D627
R625 33.2K
-150V (DCPL #2)

B



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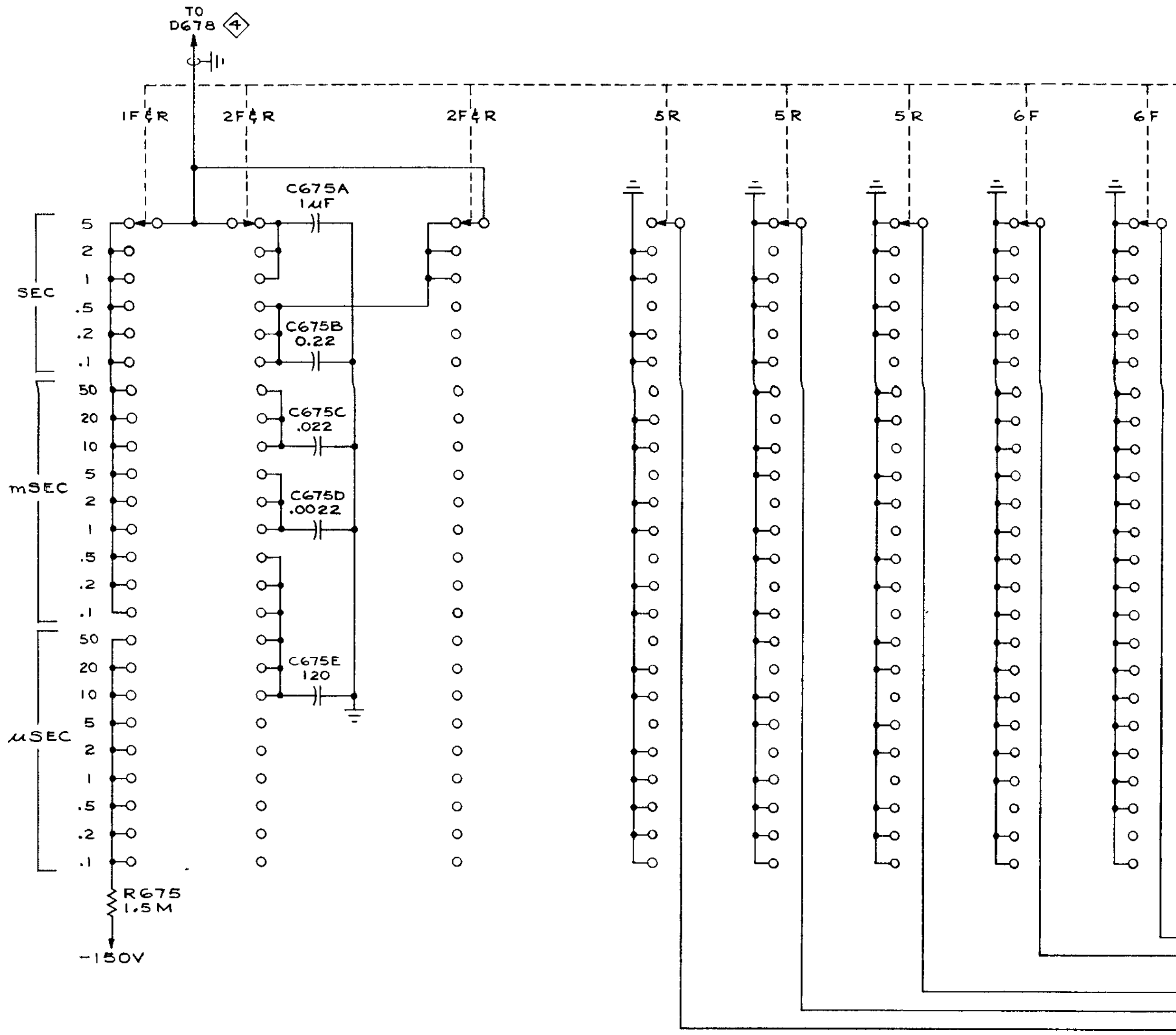
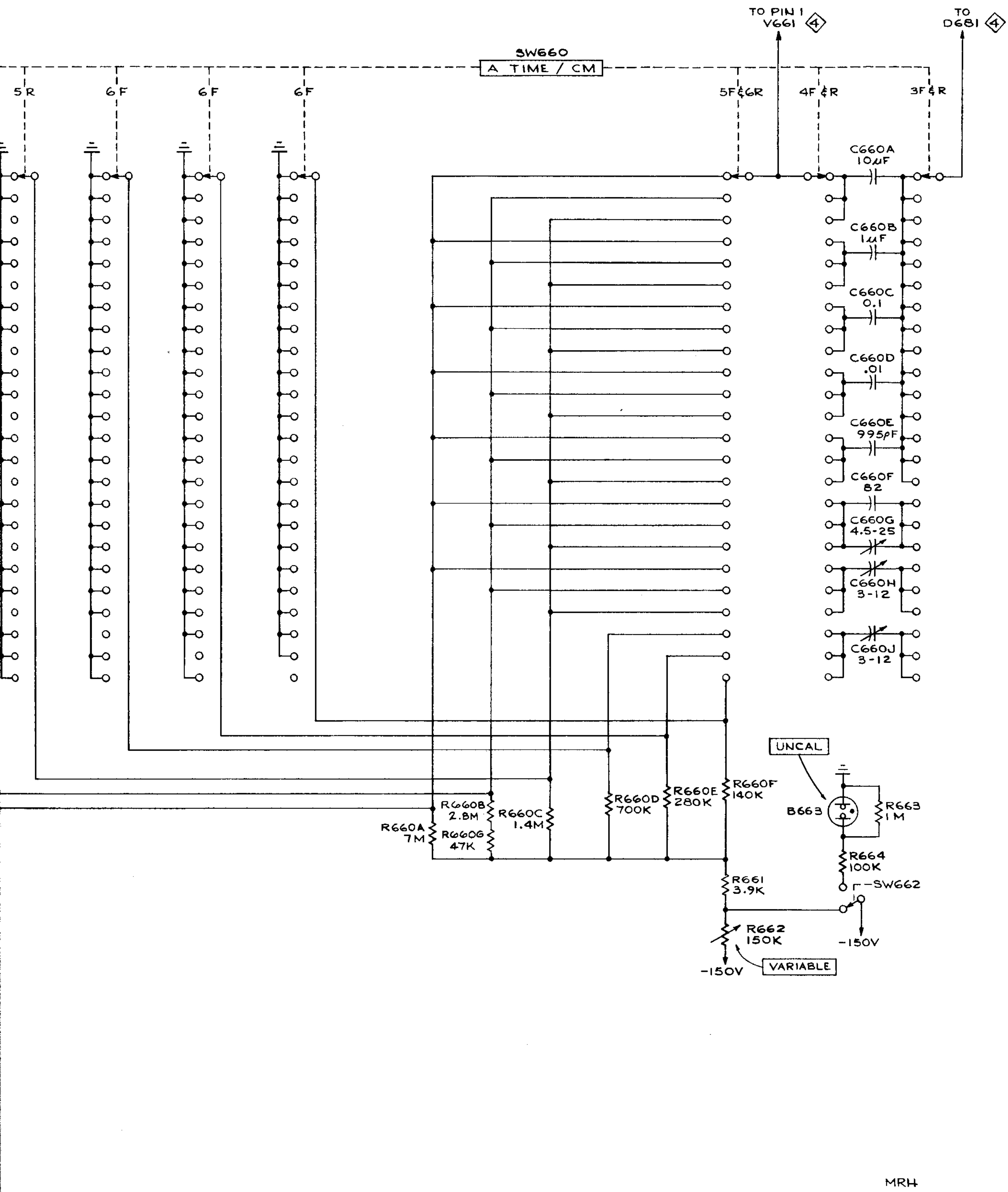
666

A SWEEP GENERATOR ④
S/N 100-1999

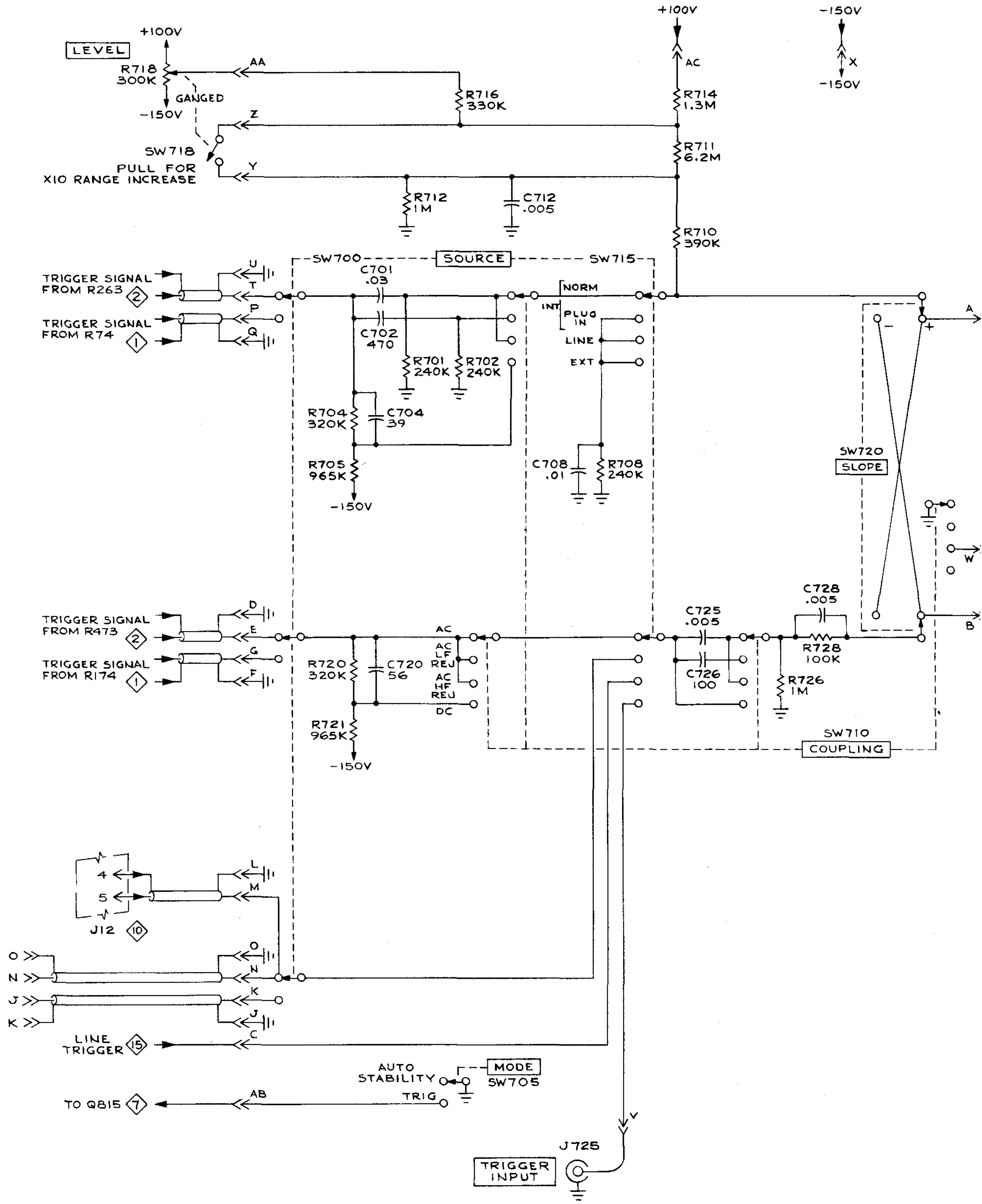


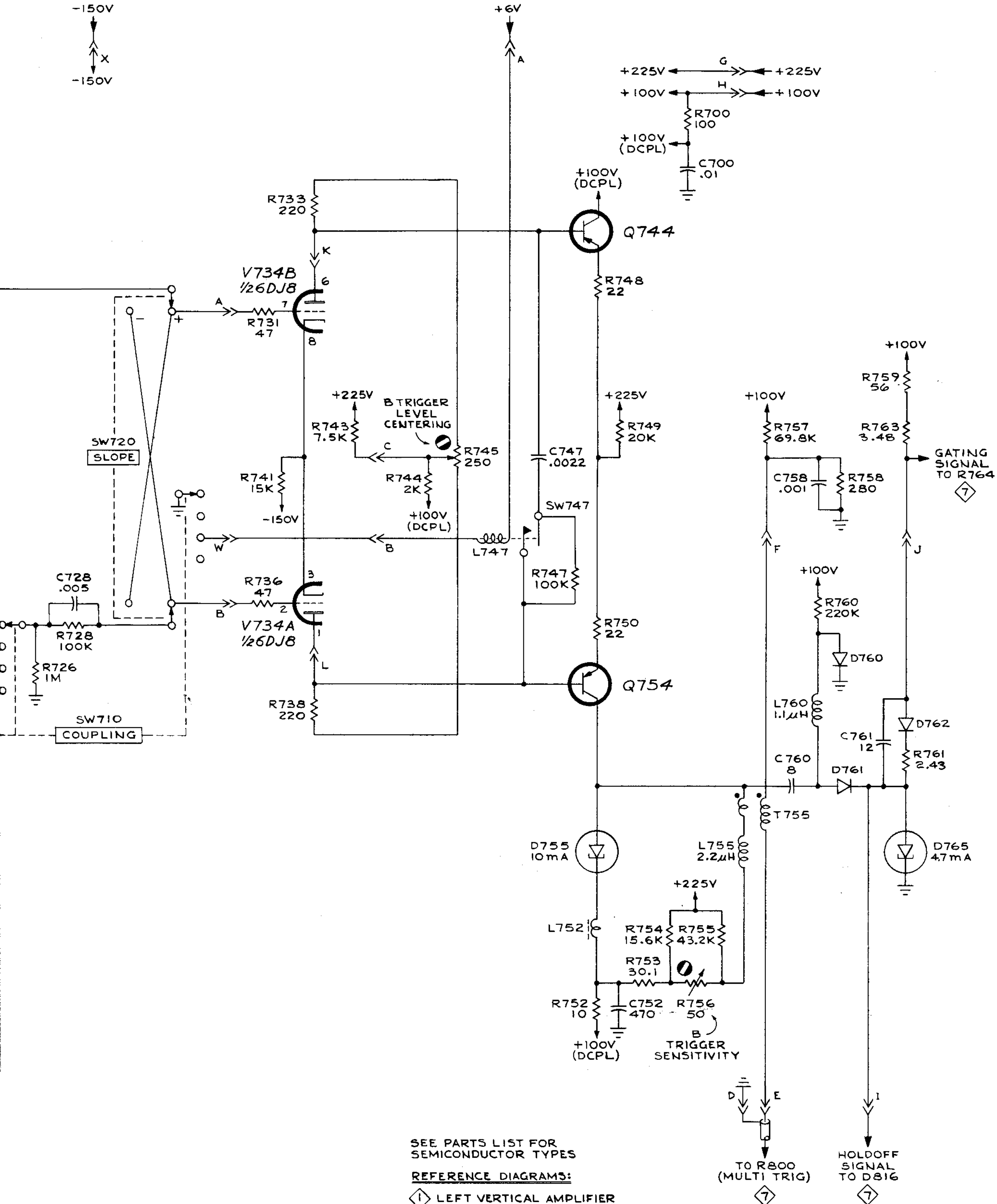
REFERENCE DIAGRAM:
4 A SWEEP GENERATOR



MRH
167

A SWEEP TIMING SWITCH 5


LEVEL
R718
300K
+100V
-150V
GANGED
SW718
PULL FOR
X10 RANGE INCREASE
R716
330K
R714
1.3M
R711
6.2M
R712
1M
C712
.005
R710
390K
SOURCE
SW700
SW715
TRIGGER SIGNAL FROM R263
TRIGGER SIGNAL FROM R74
C701
.03
C702
470
R701
240K
R702
240K
R704
320K
C704
39
R705
965K
NORM
INT
PLUG IN
LINE
EXT
C708
.01
R708
240K
SW720
SLOPE
TRIGGER SIGNAL FROM R473
TRIGGER SIGNAL FROM R174
R720
320K
C720
56
R721
965K
AC
AC LF REJ
AC HF REJ
DC
C725
.005
C726
100
C728
.005
R728
100K
R726
1M
SW710
COUPLING
J12
LINE TRIGGER
AUTO STABILITY
TRIG
MODE
SW705
TO Q815
J725
TRIGGER INPUT



SEE PARTS LIST FOR SEMICONDUCTOR TYPES

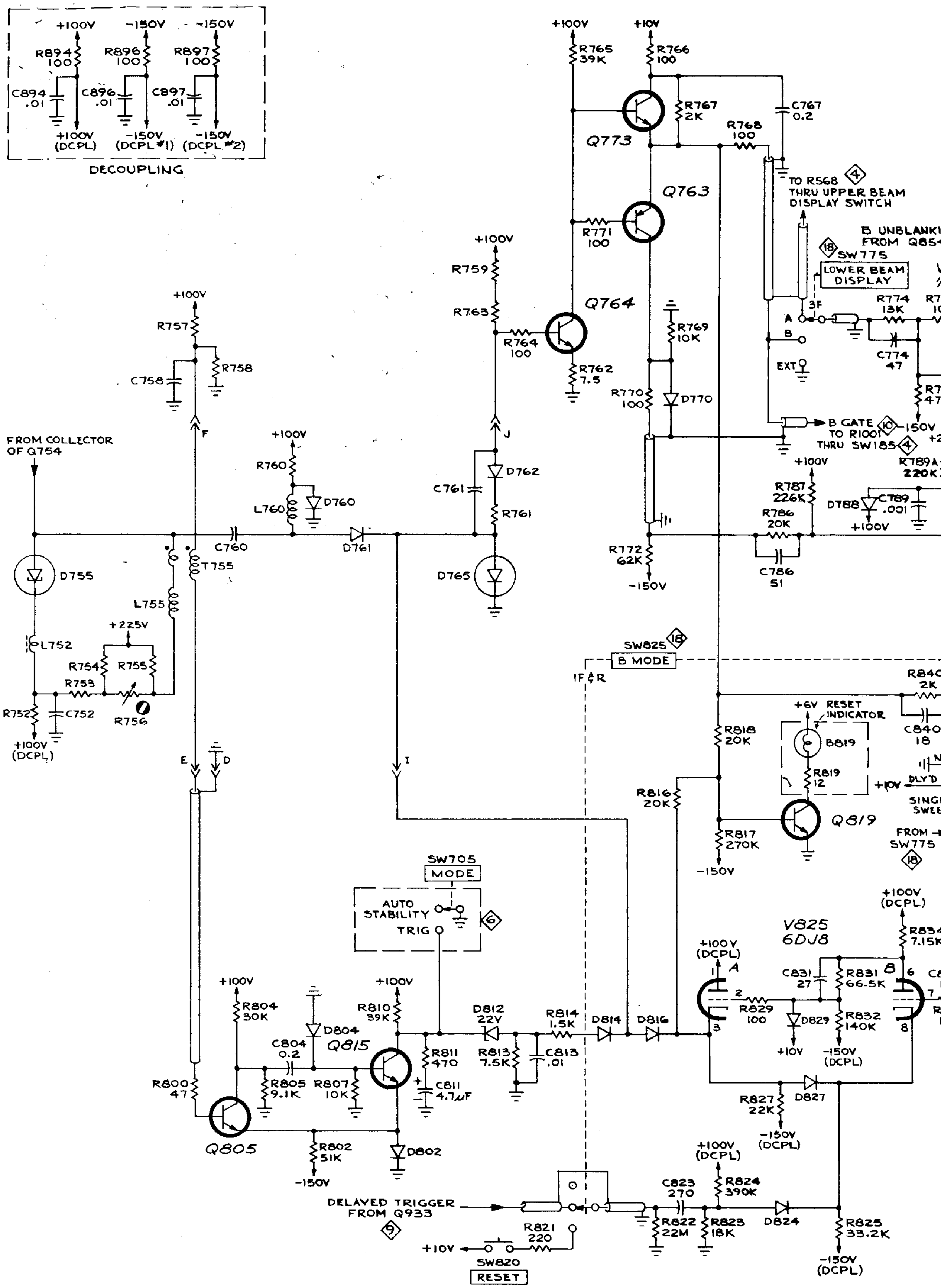
REFERENCE DIAGRAMS:

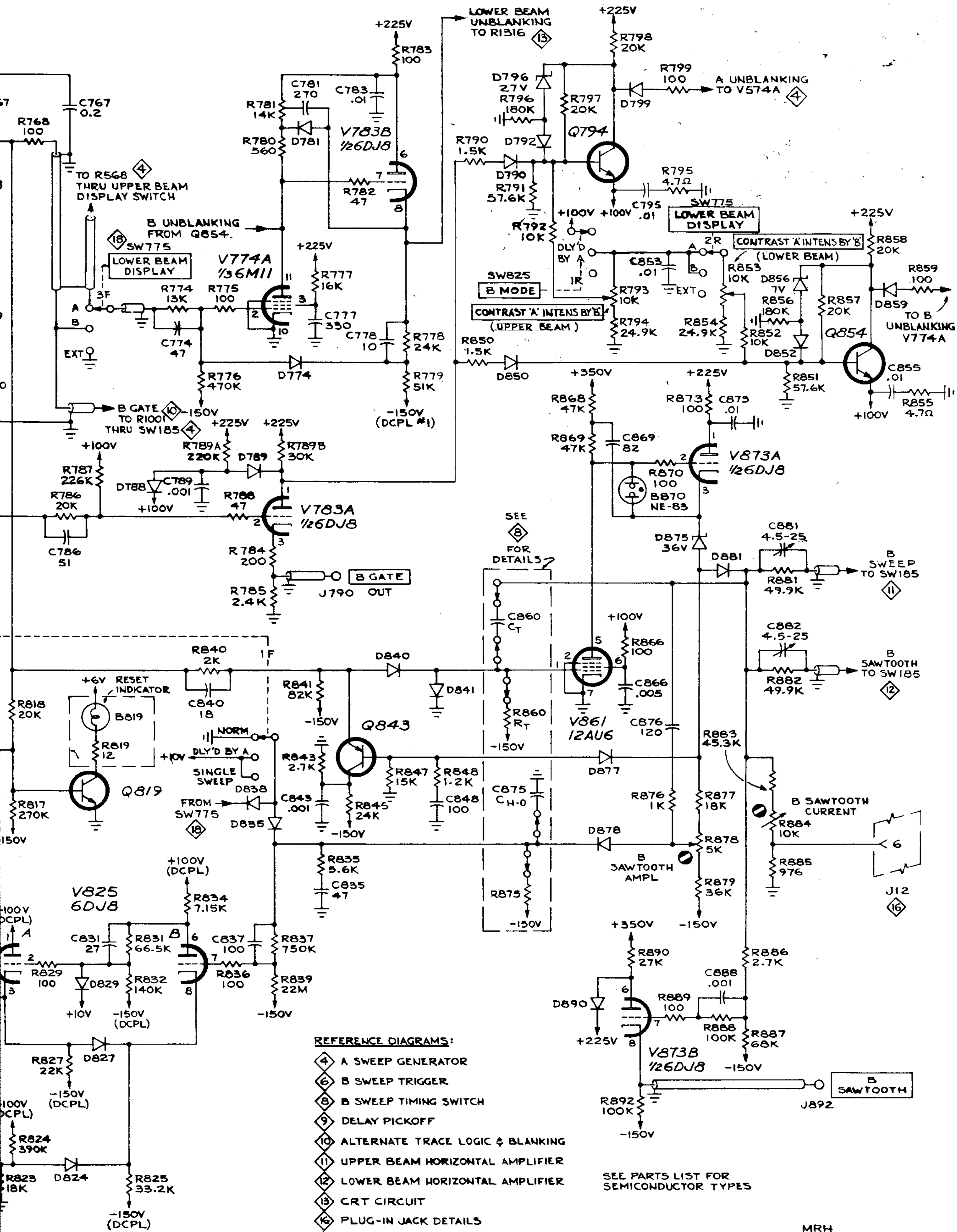
1 LEFT VERTICAL AMPLIFIER
2 RIGHT VERTICAL AMPLIFIER
3 A SWEEP TRIGGER
7 B SWEEP GENERATOR
15 HEATER WIRING
16 PLUG-IN JACK DETAILS

MRH
666

B

B SWEEP TRIGGER 6


+100V
-150V
-150V
R894
100
R896
100
R897
100
C894
.01
C896
.01
C897
.01
+100V (DCPL)
-150V (DCPL #1)
-150V (DCPL #2)
DECOUPLING
+100V
+10V
R765
39K
R766
100
R767
2K
C767
0.2
R768
100
Q773
Q763
TO R568
THRU UPPER BEAM DISPLAY SWITCH
R771
100
B UNBLANKI
FROM Q85
SW775
LOWER BEAM DISPLAY
+100V
R759
R763
Q764
R764
100
R762
7.5
R769
10K
R774
13K
C774
47
EXT
R770
100
D770
B GATE
TO R1001
THRU SW185
-150V
R789A
220K
+100V
R787
226K
R786
20K
D788
C789
.001
+100V
R772
62K
C786
51
-150V
+100V
R757
R758
C758
F
FROM COLLECTOR OF Q754
+100V
R760
L760
D760
C761
D762
J
R761
C760
D761
T755
D755
D765
L755
L752
+225V
R754
R755
R753
R752
C752
R756
+100V (DCPL)
E
D
I
SW825
B MODE
IF & R
R840
2K
C840
18
+6V RESET INDICATOR
B819
R819
12
R818
20K
R816
20K
R817
270K
-150V
Q819
+10V
DLY'D
SINGLE SWEEP
FROM
SW775
SW705
MODE
AUTO STABILITY
TRIG
+100V (DCPL)
V825
6DJ8
R834
7.15K
+100V (DCPL)
C831
27
R831
66.5K
R829
100
D829
R832
140K
+10V
-150V (DCPL)
+100V
R804
30K
+100V
R810
39K
D804
C804
0.2
Q815
D812
22V
R814
1.5K
D814
D816
R811
470
R813
7.5K
C813
.01
C811
4.7µF
R800
47
R805
9.1K
R807
10K
Q805
R802
51K
D802
-150V
R827
22K
D827
-150V (DCPL)
+100V (DCPL)
C823
270
R824
390K
DELAYED TRIGGER FROM Q933
R822
22M
R823
18K
D824
R825
33.2K
-150V (DCPL)
R821
220
+10V
SW820
RESET



REFERENCE DIAGRAMS:

4. A SWEEP GENERATOR
6. B SWEEP TRIGGER
8. B SWEEP TIMING SWITCH
9. DELAY PICKOFF
10. ALTERNATE TRACE LOGIC & BLANKING
11. UPPER BEAM HORIZONTAL AMPLIFIER
12. LOWER BEAM HORIZONTAL AMPLIFIER
13. CRT CIRCUIT
16. PLUG-IN JACK DETAILS
18. HORIZONTAL DISPLAY & MODE SWITCHING

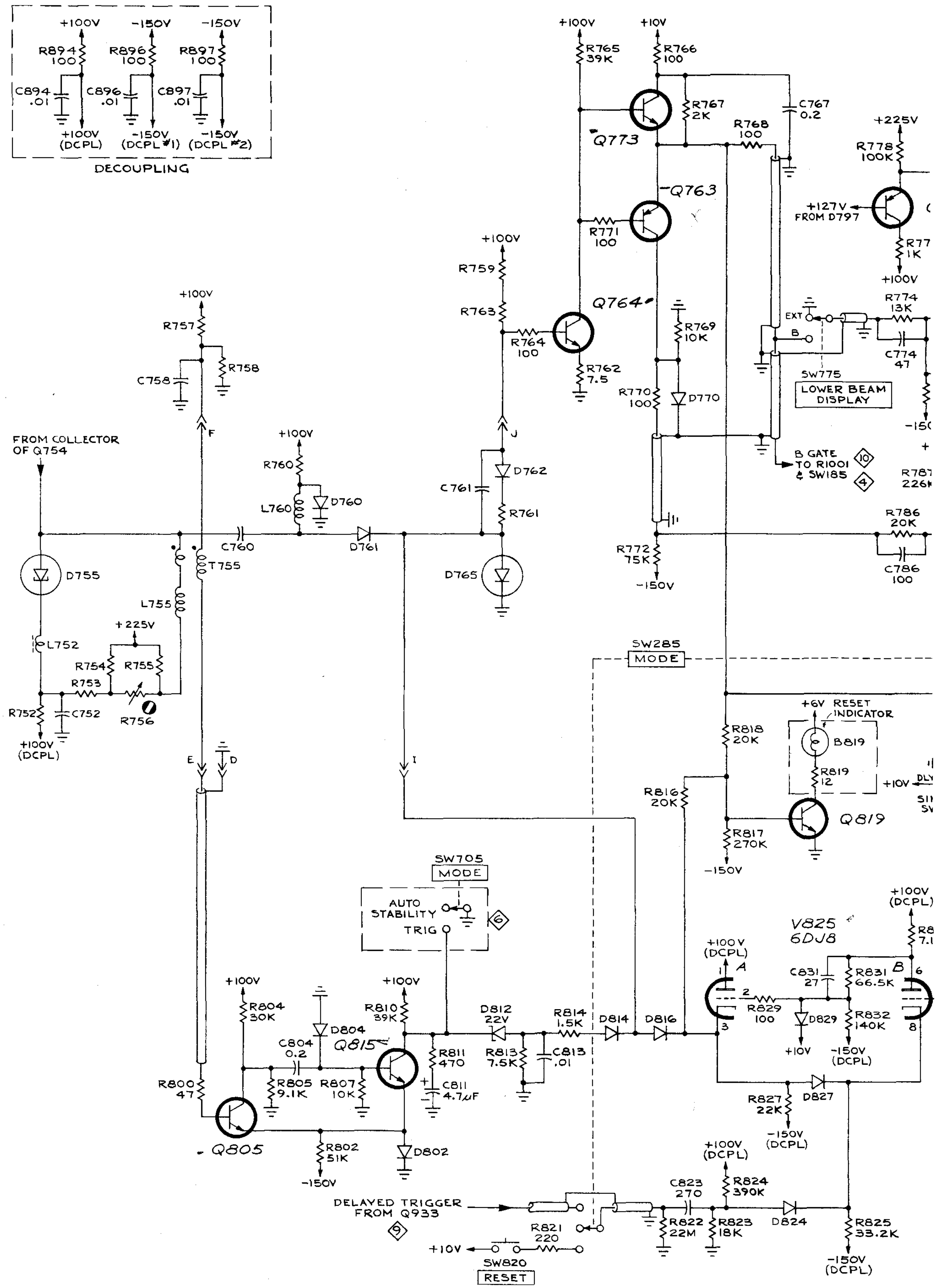
SEE PARTS LIST FOR SEMICONDUCTOR TYPES

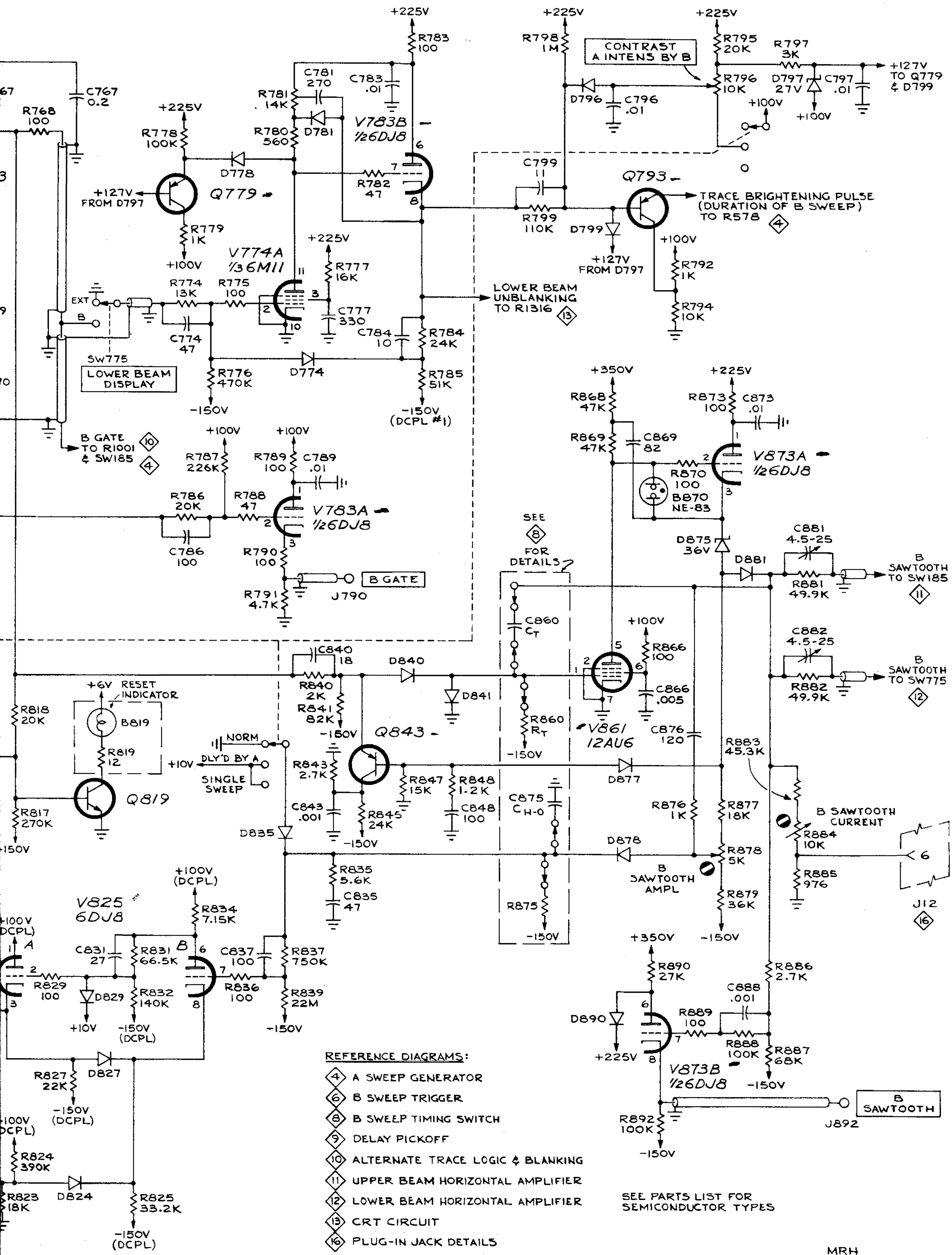
MRH
867

A

B SWEEP GENERATOR 7

S/N 2000-UP


DECOUPLING
+100V
R894 100
C894 .01
+100V (DCPL)
-150V
R896 100
C896 .01
-150V (DCPL #1)
-150V
R897 100
C897 .01
-150V (DCPL #2)
FROM COLLECTOR OF Q754
D755
L752
R752
C752
+100V (DCPL)
R753
R754
R755
+225V
R756
L755
T755
R757
R758
C758
+100V
C760
R760
L760
D760
D761
C761
D762
R761
D765
R759
R763
R764 100
R762 7.5
Q764
+100V
R765 39K
+10V
R766 100
R767 2K
Q773
Q763
R771 100
C767 0.2
R768 100
R769 10K
R770 100
D770
R772 75K
-150V
+225V
R778 100K
+127V FROM D797
+100V
R774 13K
C774 47
EXT
B
SW775
LOWER BEAM DISPLAY
B GATE TO R1001 & SW185
R786 20K
C786 100
SW285
MODE
+6V
RESET INDICATOR
B819
R819 12
+10V
Q819
R818 20K
R816 20K
R817 270K
-150V
SW705
MODE
AUTO STABILITY
TRIG
+100V
R804 30K
D804
C804 0.2
R805 9.1K
R807 10K
R800 47
Q805
R802 51K
-150V
+100V
R810 39K
Q815
R811 470
C811 4.7µF
D802
D812 22V
R813 7.5K
C813 .01
R814 1.5K
D814
D816
V825 6DJ8
+100V (DCPL)
C831 27
R831 66.5K
R829 100
D829
+10V
R832 140K
-150V (DCPL)
R827 22K
-150V (DCPL)
D827
+100V (DCPL)
R824 390K
C823 270
R822 22M
R823 18K
D824
R825 33.2K
-150V (DCPL)
DELAYED TRIGGER FROM Q933
R821 220
+10V
SW820
RESET



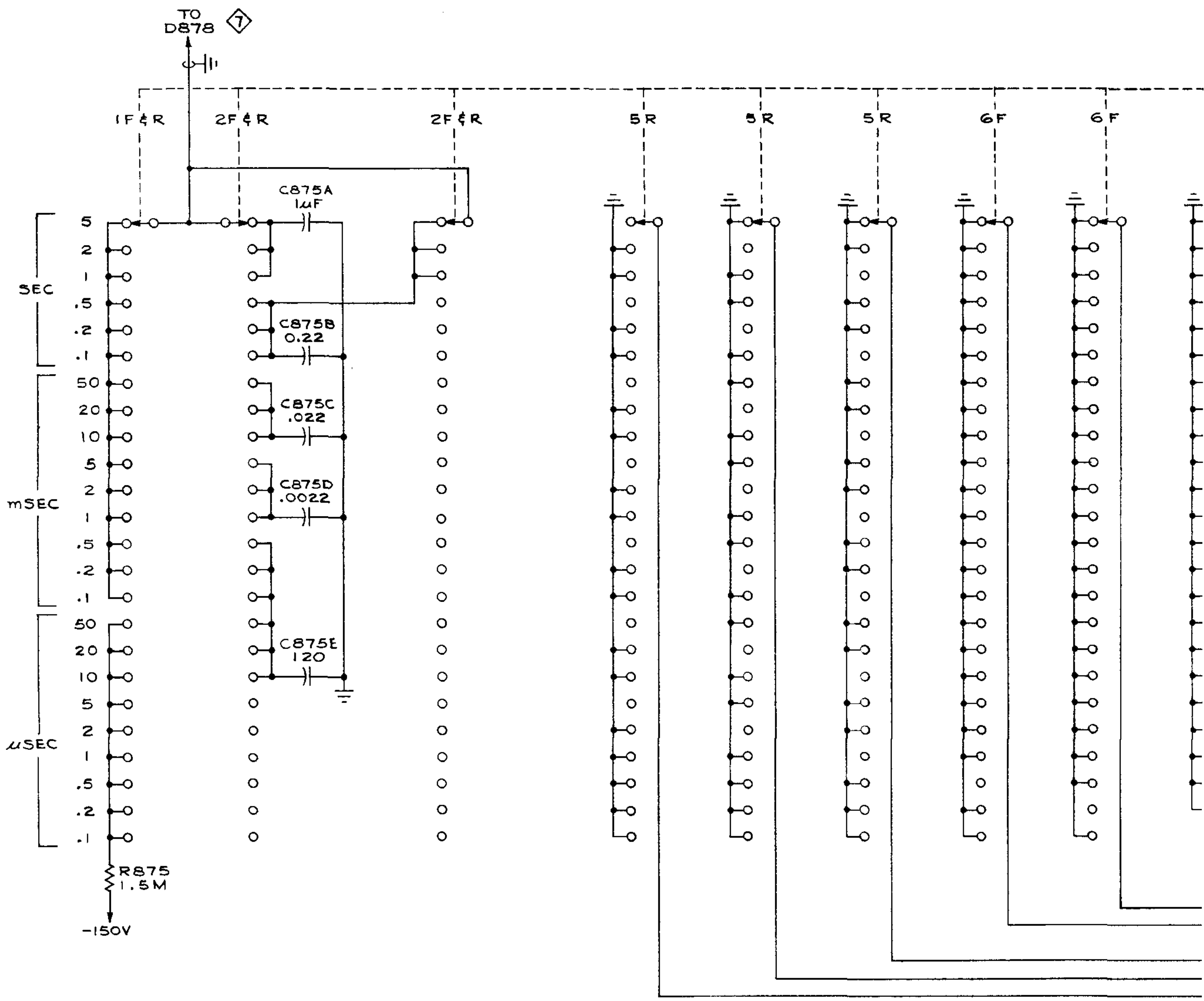
REFERENCE DIAGRAMS:

- 4 A SWEEP GENERATOR
- 6 B SWEEP TRIGGER
- 8 B SWEEP TIMING SWITCH
- 9 DELAY PICKOFF
- 10 ALTERNATE TRACE LOGIC & BLANKING
- 11 UPPER BEAM HORIZONTAL AMPLIFIER
- 12 LOWER BEAM HORIZONTAL AMPLIFIER
- 13 CRT CIRCUIT
- 16 PLUG-IN JACK DETAILS

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

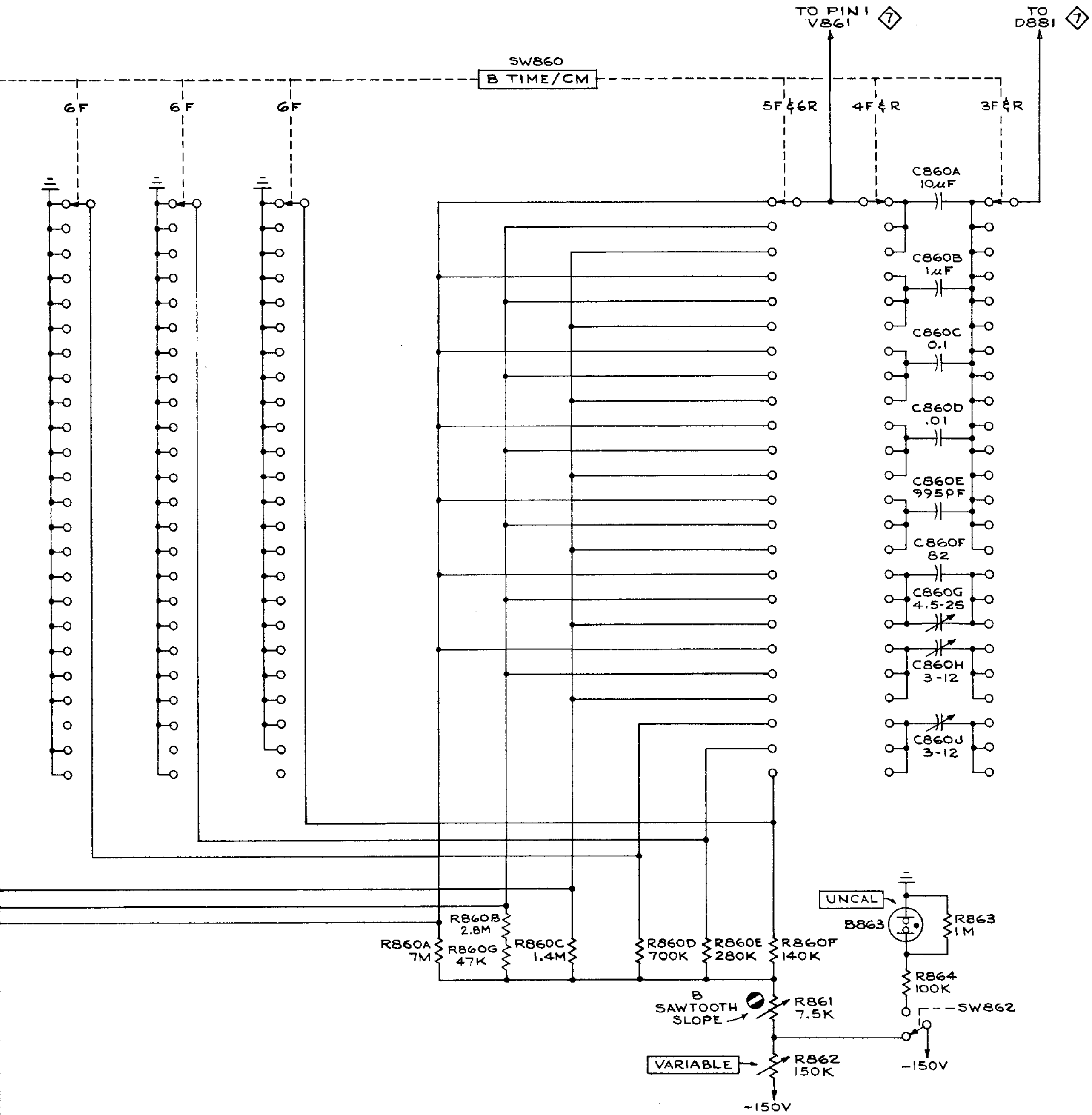
MRH
1266

B SWEEP GENERATOR 7
S/N 100-1999



REFERENCE DIAGRAM:

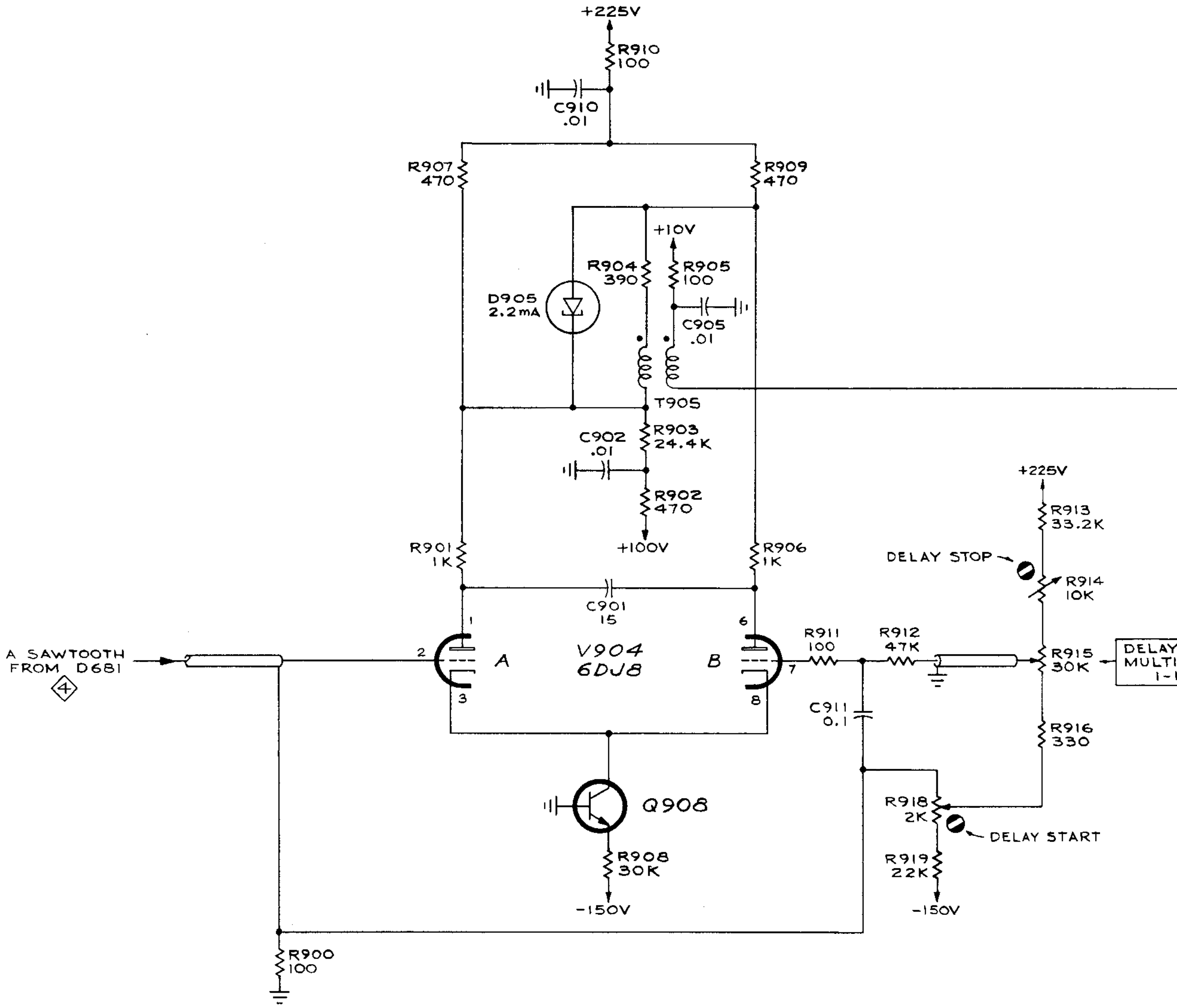
⟨7⟩ B SWEEP GENERATOR

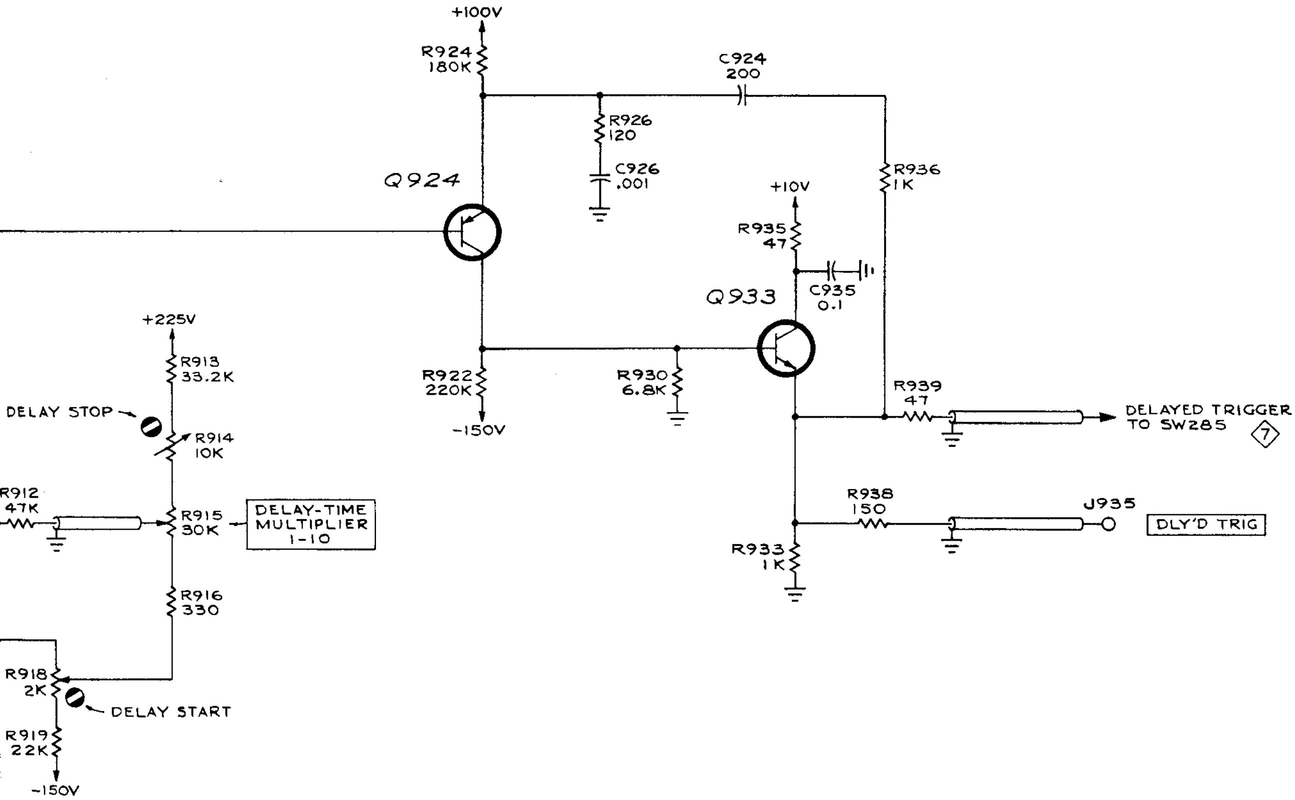


MRH
167

B SWEEP TIMING SWITCH 8

C


+225V
R910 100
C910 .01
R907 470
R909 470
+10V
R904 390
R905 100
D905 2.2mA
C905 .01
T905
C902 .01
R903 24.4K
R902 470
+100V
R901 1K
R906 1K
C901 15
A SAWTOOTH FROM D681
4
V904 6DJ8
A
B
R911 100
R912 47K
C911 0.1
+225V
R913 33.2K
DELAY STOP
R914 10K
R915 30K
DELAY MULTI 1-1
R916 330
Q908
R918 2K
DELAY START
R919 22K
-150V
R908 30K
-150V
R900 100



SEE PARTS LIST FOR SEMICONDUCTOR TYPES

REFERENCE DIAGRAMS:

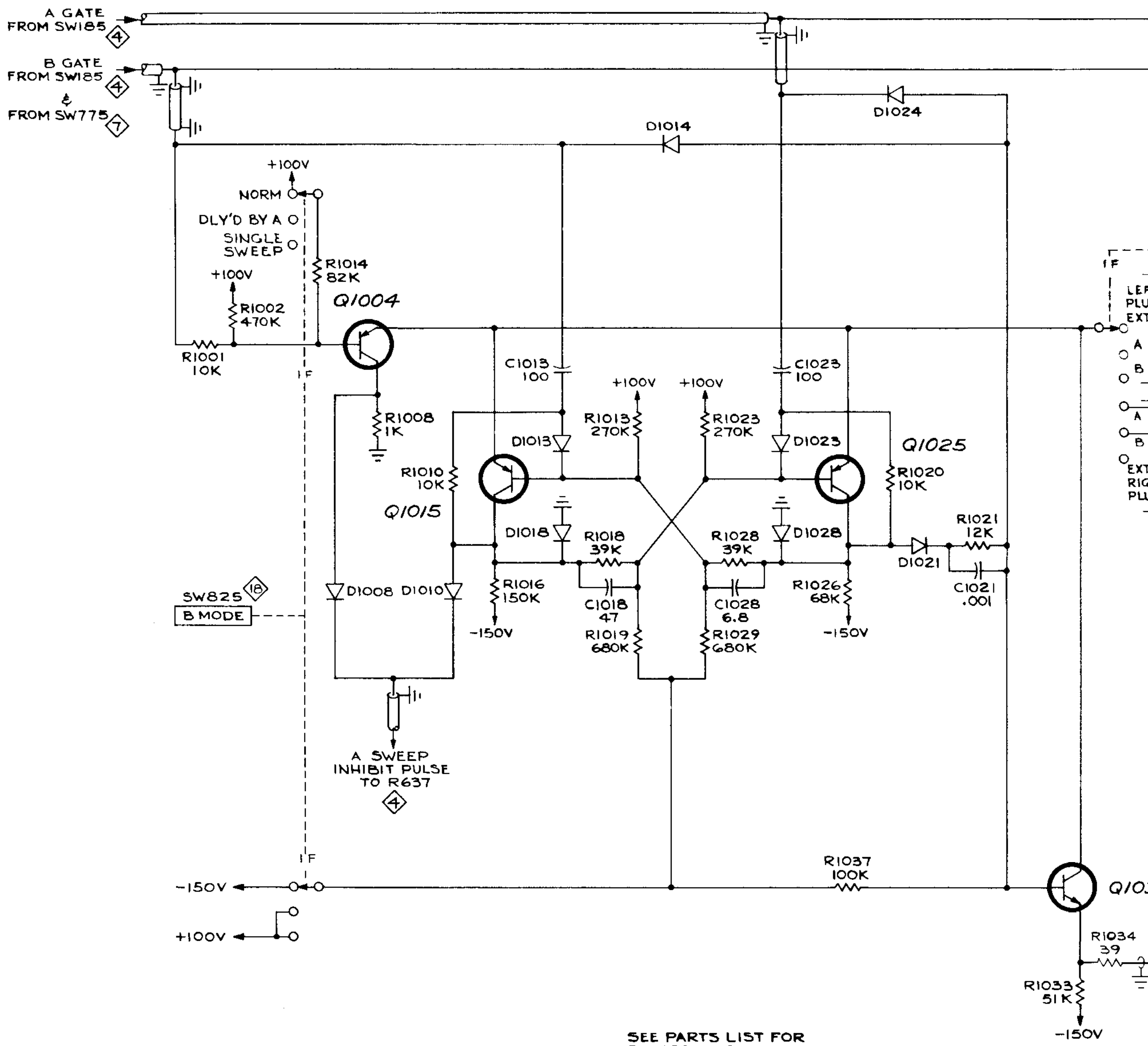
4 A SWEEP GENERATOR

7 B SWEEP GENERATOR

MRH 666

B

DELAY PICKOFF 9



SEE PARTS LIST FOR SEMICONDUCTOR TYPES

REFERENCE DIAGRAMS:

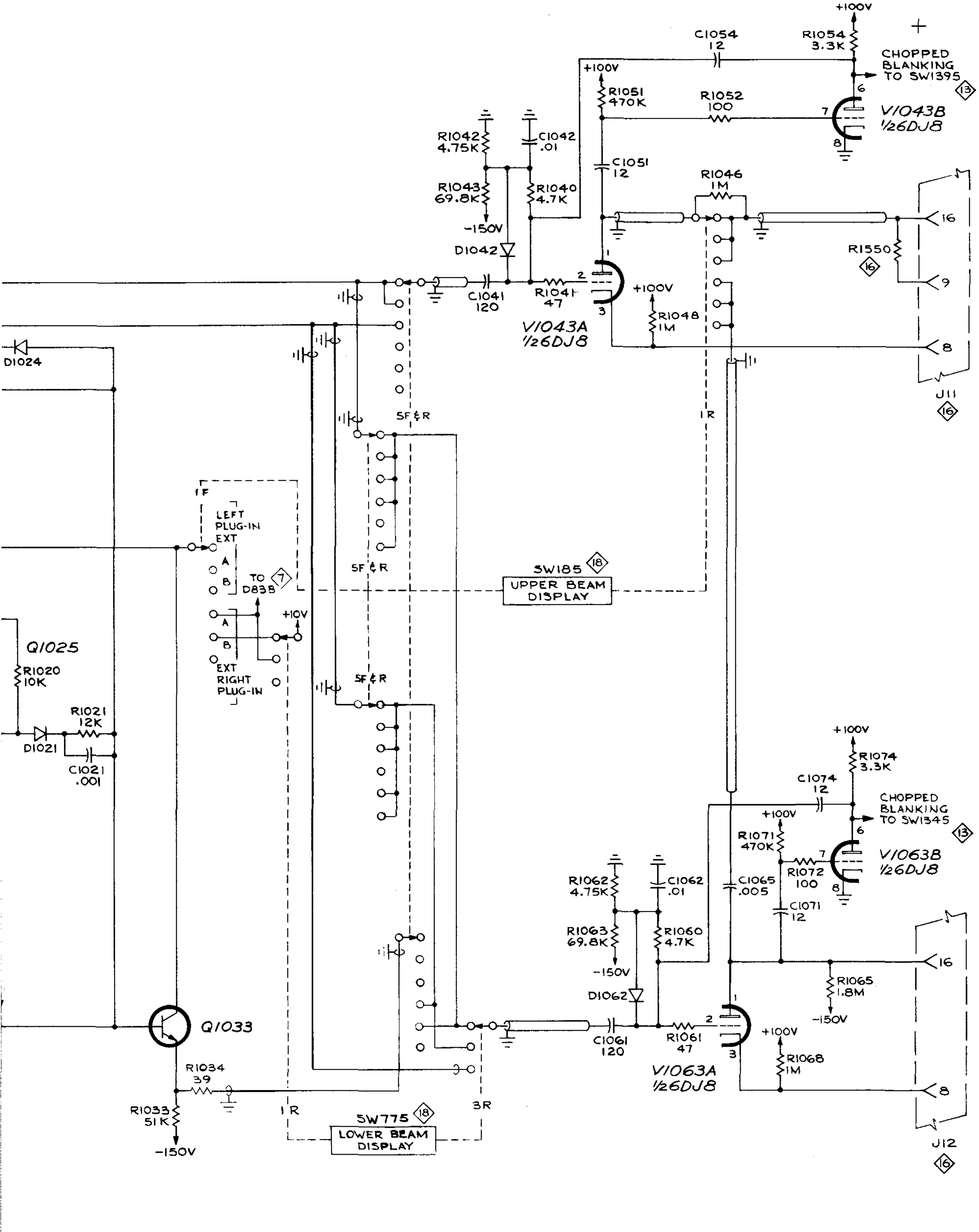
4 A SWEEP GENERATOR

7 B SWEEP GENERATOR

13 CRT CIRCUIT

16 PLUG-IN JACK DETAILS

18 HORIZONTAL DISPLAY & MODE SWITCHING



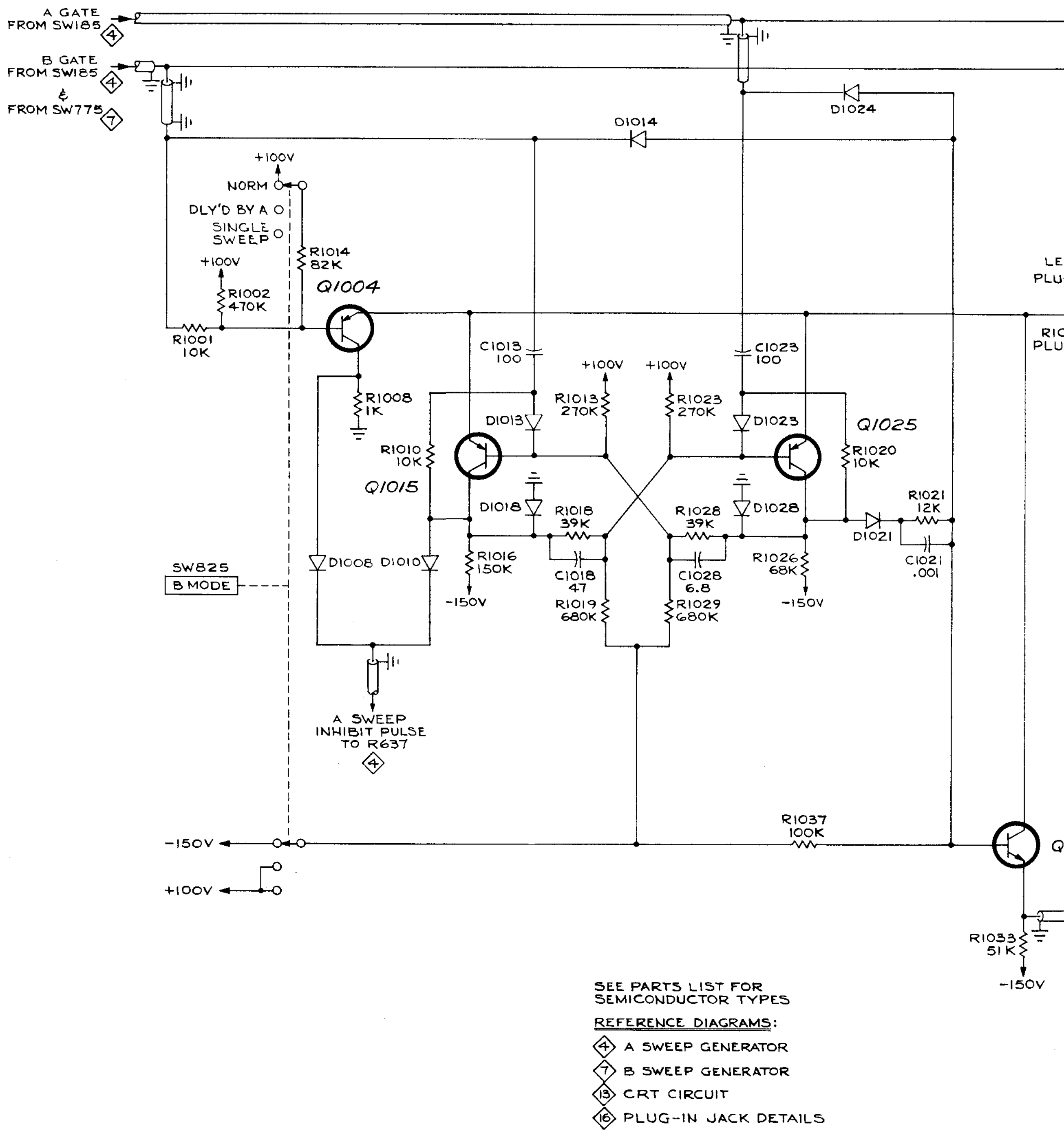
DE SWITCHING

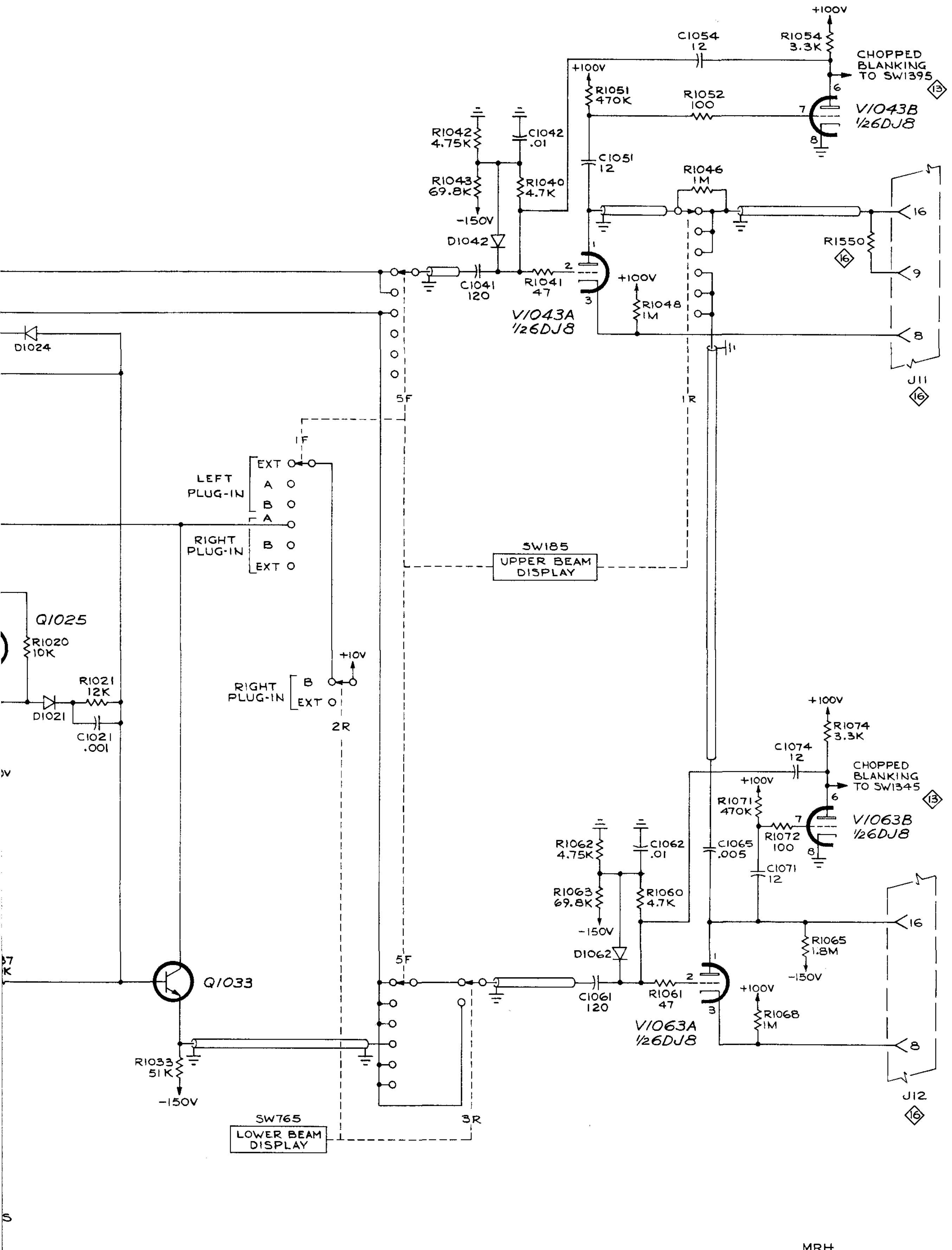
MRH
867

A

ALTERNATE TRACE LOGIC & BLANKING 10

S/N 2000-UP

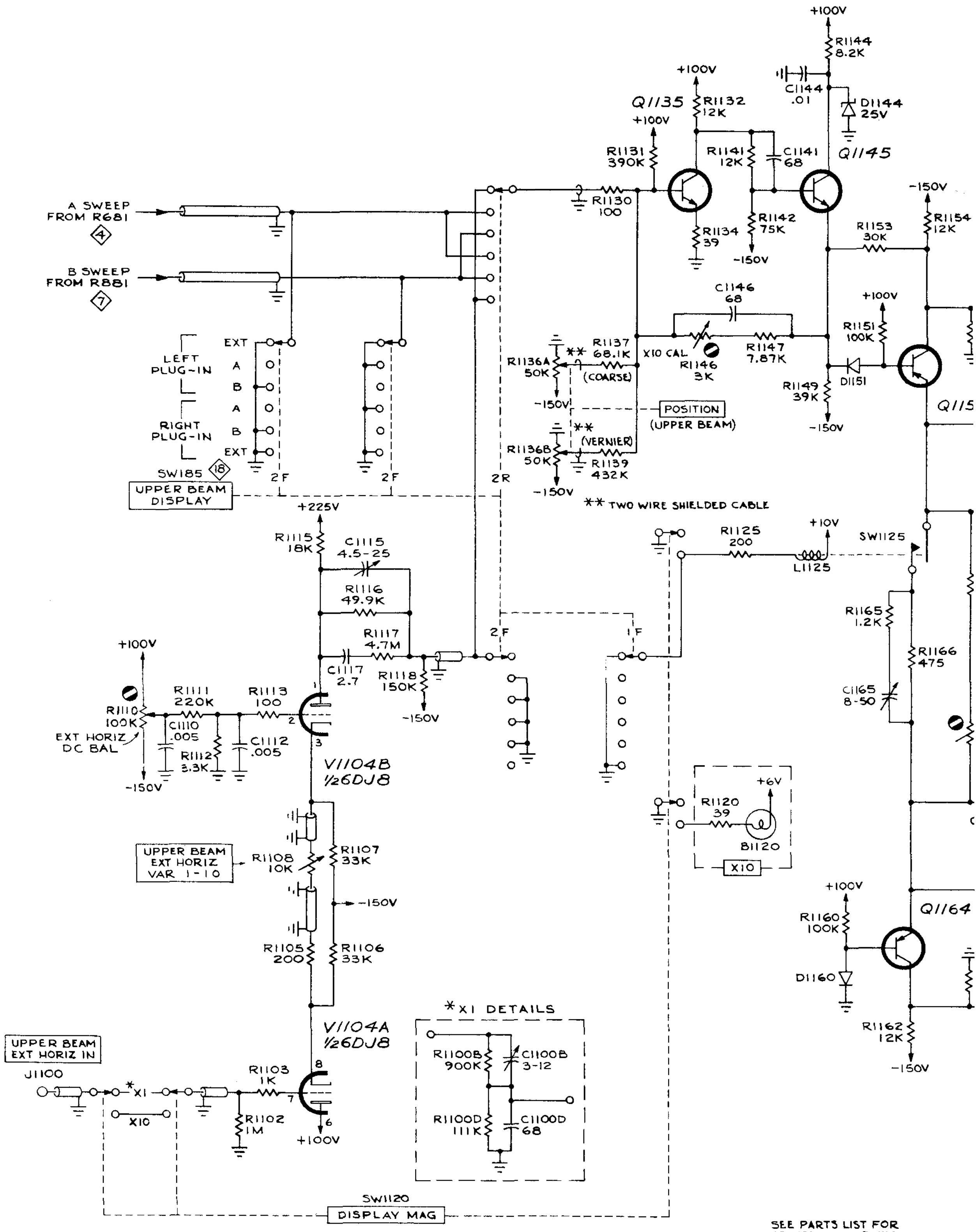

A GATE FROM SW185 4
B GATE FROM SW185 4 & FROM SW775 7
D1014
D1024
+100V
NORM
DLY'D BY A
SINGLE SWEEP
R1014 82K
+100V
R1002 470K
Q1004
R1001 10K
C1013 100
C1023 100
+100V
+100V
R1008 1K
R1013 270K
R1023 270K
D1013
D1023
Q1025
R1010 10K
R1020 10K
Q1015
D1018
R1018 39K
R1028 39K
D1028
R1021 12K
D1021
SW825
B MODE
D1008
D1010
R1016 150K
C1018 47
C1028 6.8
R1026 68K
C1021 .001
-150V
R1019 680K
R1029 680K
-150V
A SWEEP INHIBIT PULSE TO R637 4
R1037 100K
-150V
+100V
R1033 51K
-150V
SEE PARTS LIST FOR SEMICONDUCTOR TYPES
REFERENCE DIAGRAMS:
4 A SWEEP GENERATOR
7 B SWEEP GENERATOR
13 CRT CIRCUIT
16 PLUG-IN JACK DETAILS



MRH
666

ALTERNATE TRACE LOGIC & BLANKING 10

S/N 100-1999



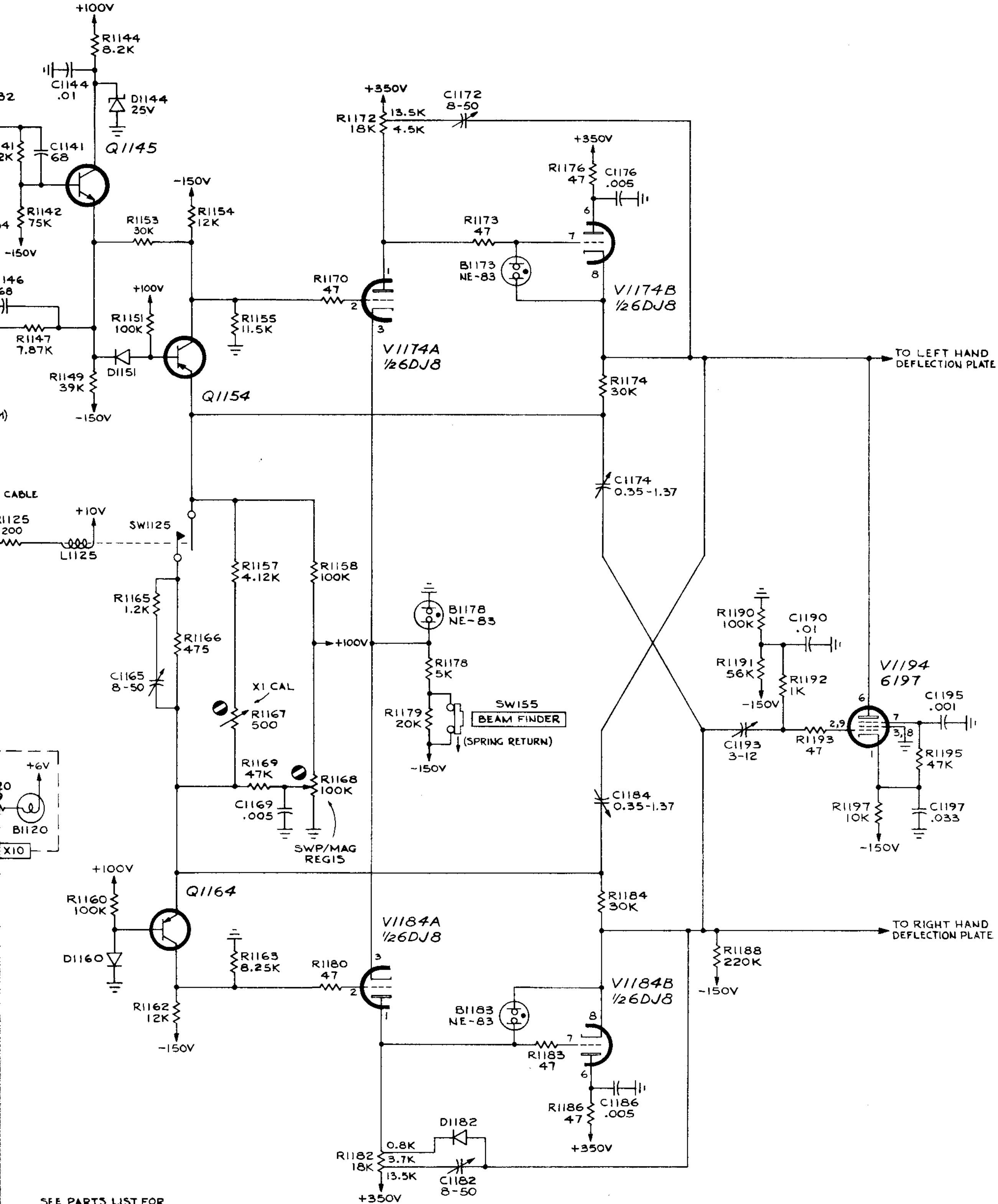
SEE PARTS LIST FOR SEMICONDUCTOR TYPES

REFERENCE DIAGRAMS:

4 A SWEEP GENERATOR

7 B SWEEP GENERATOR

18 HORIZONTAL DISPLAY & MO



SEE PARTS LIST FOR SEMICONDUCTOR TYPES

REFERENCE DIAGRAMS:

4 A SWEEP GENERATOR

7 B SWEEP GENERATOR

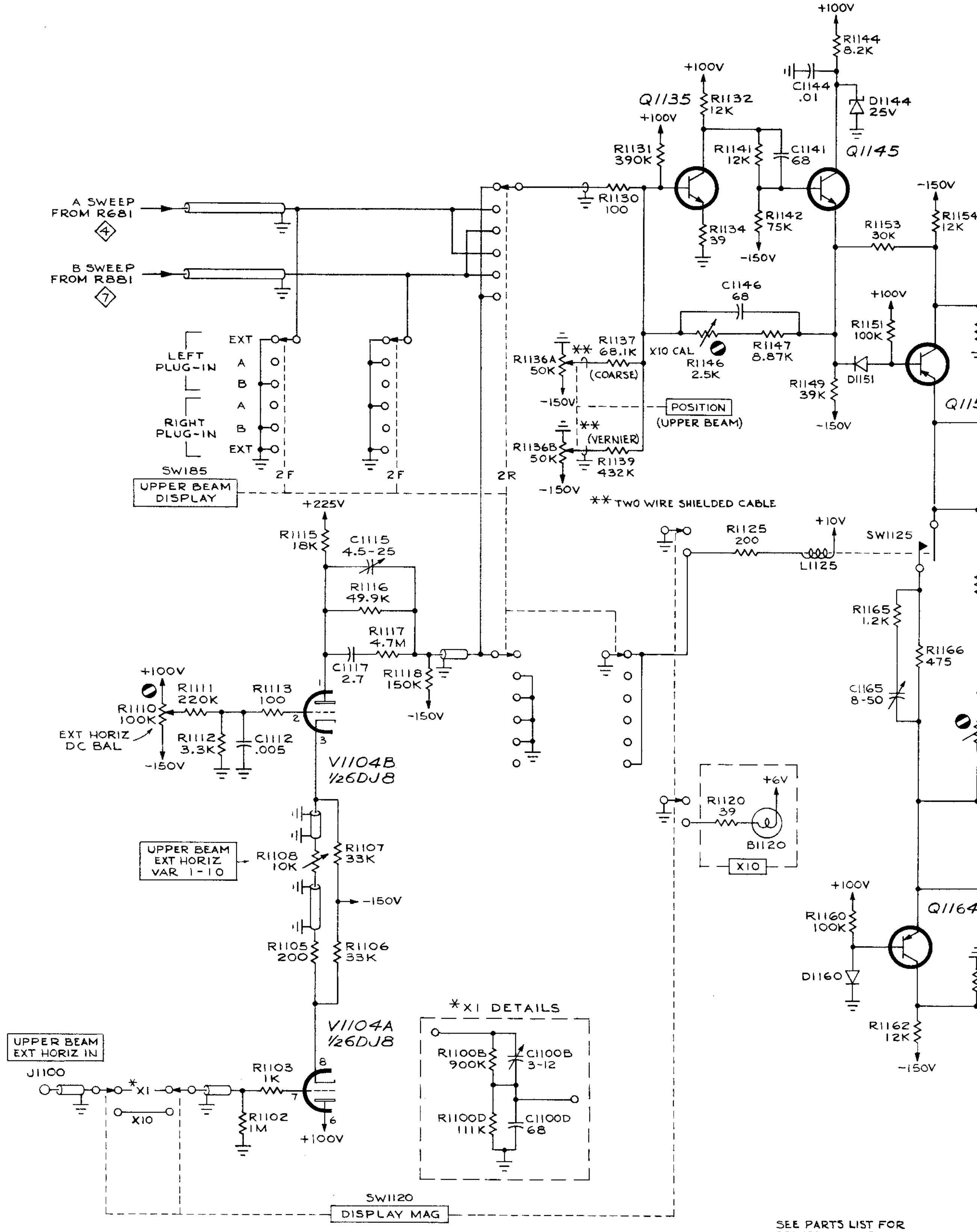
18 HORIZONTAL DISPLAY & MODE SWITCHING

MRH
867

A

UPPER BEAM HORIZONTAL AMPLIFIER 11

S/N 2000-UP

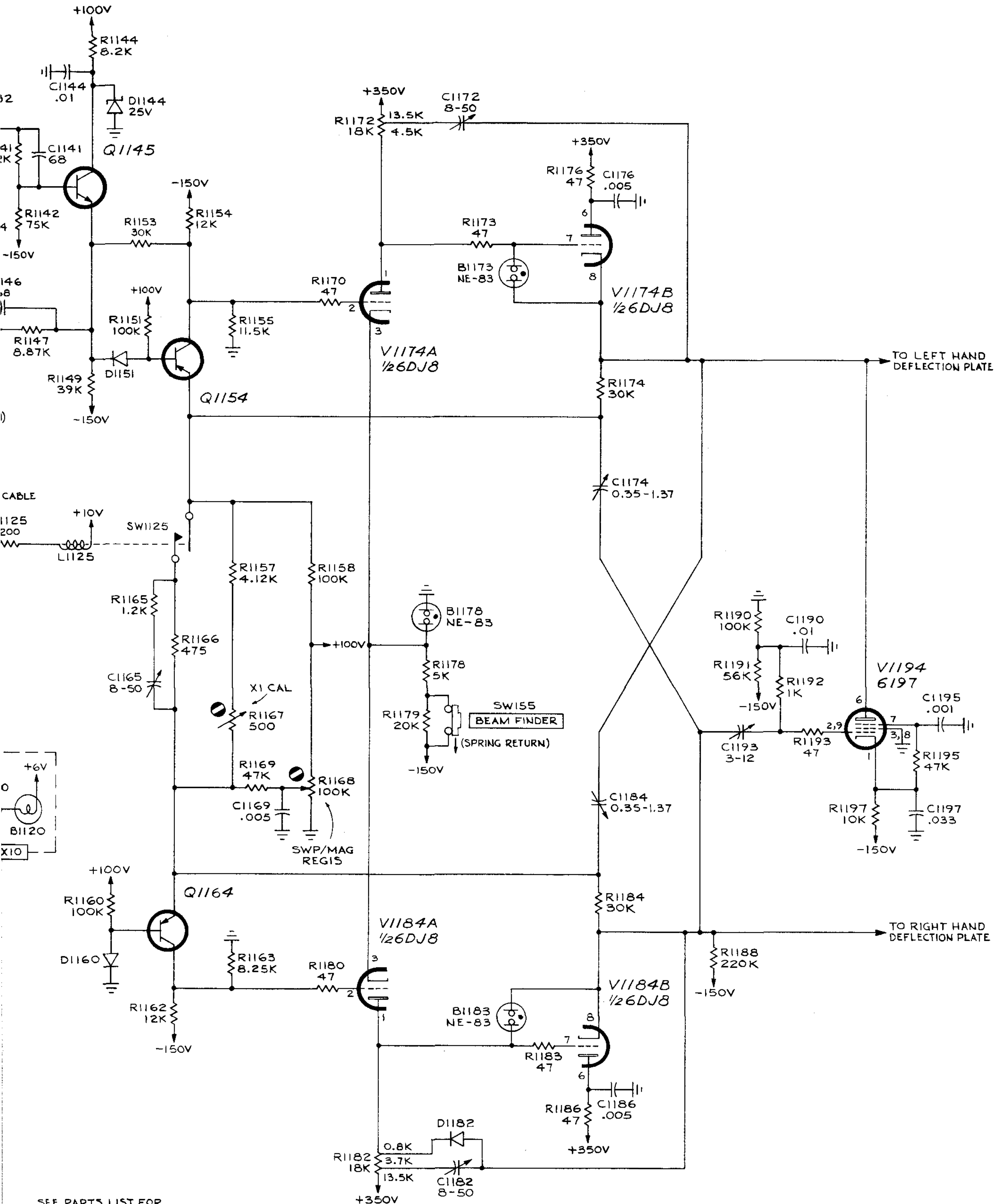


SEE PARTS LIST FOR SEMICONDUCTOR TYPES

REFERENCE DIAGRAMS:

4 A SWEEP GENERATOR

7 B SWEEP GENERATOR



SEE PARTS LIST FOR
SEMICONDUCTOR TYPES

REFERENCE DIAGRAMS:

4 A SWEEP GENERATOR

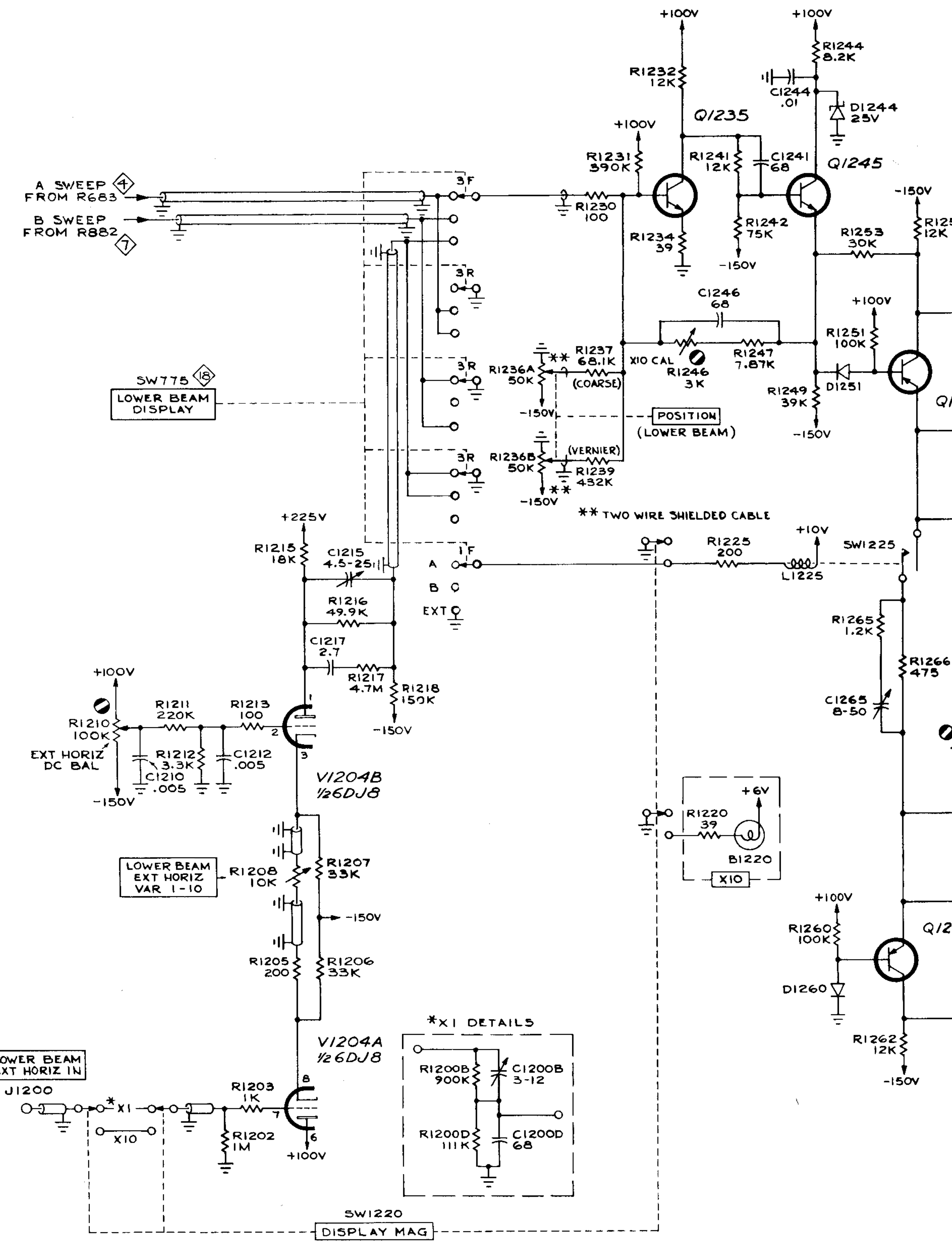
7 B SWEEP GENERATOR

MRH
666

B

UPPER BEAM HORIZONTAL AMPLIFIER 11

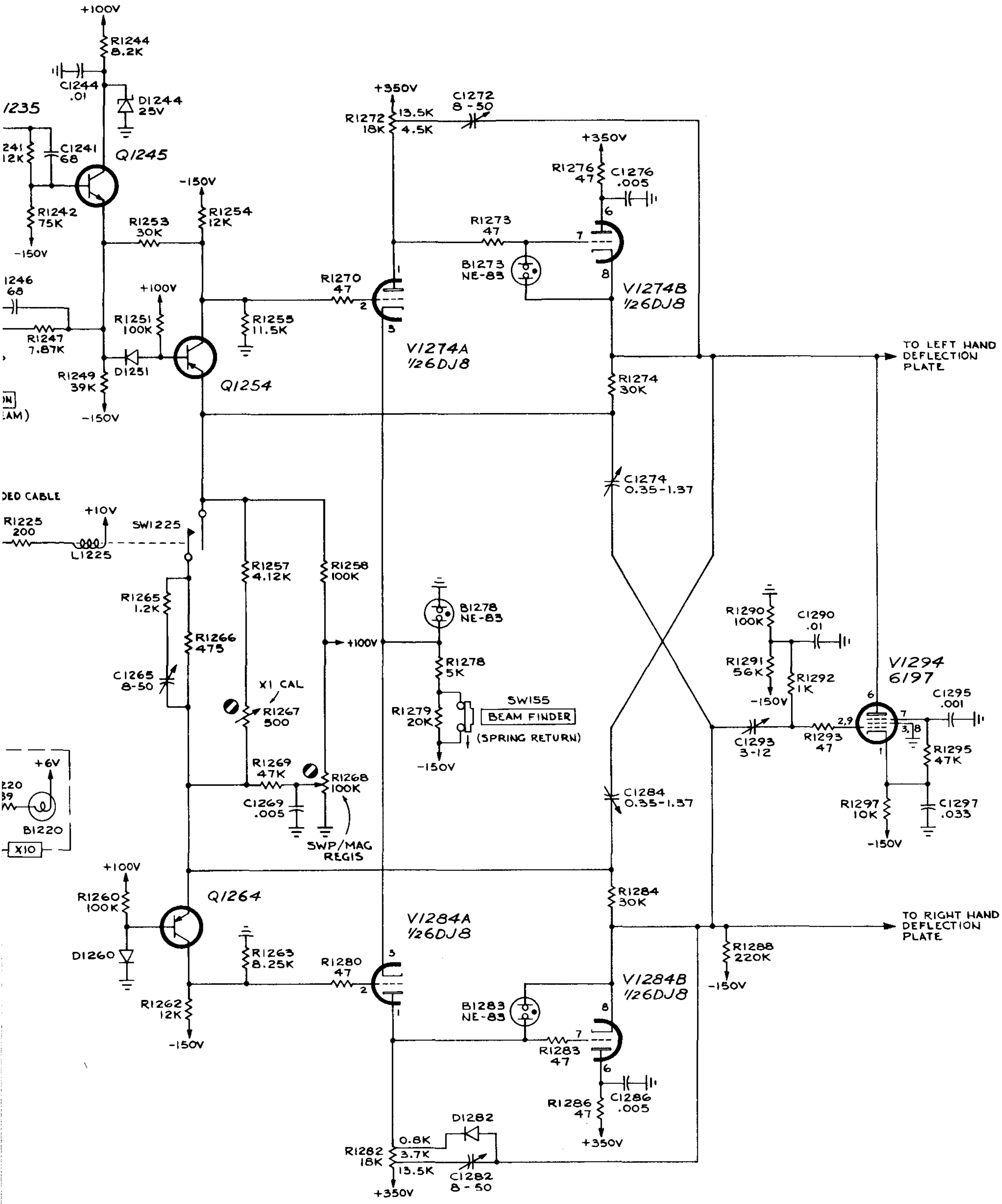
S/N 100-1999



SEE PARTS LIST FOR SEMICONDUCTOR TYPES

REFERENCE DIAGRAM:

⑦ B SWEEP GENERATOR



SEE PARTS LIST FOR SEMICONDUCTOR TYPES

REFERENCE DIAGRAM:

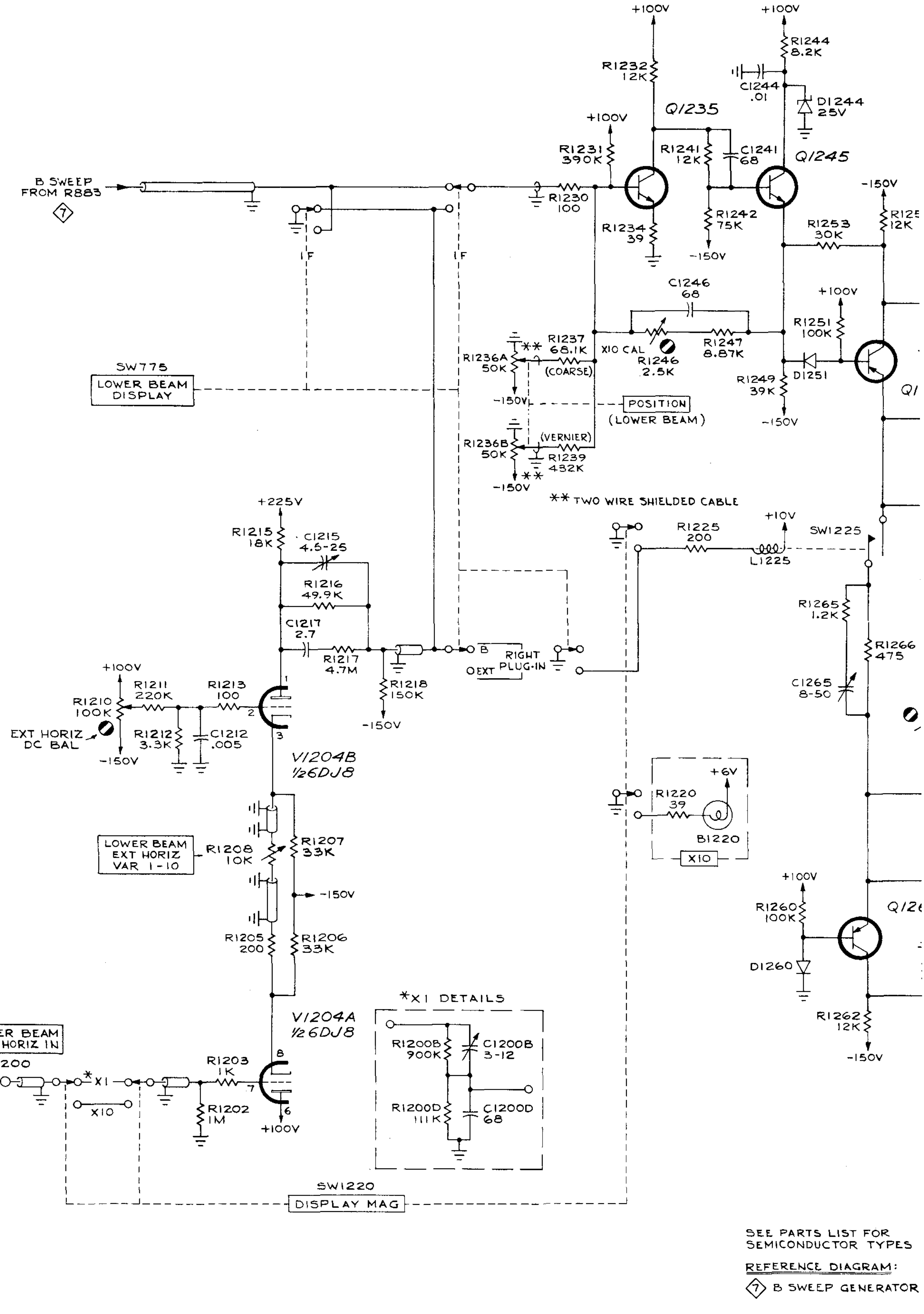
⑦ B SWEEP GENERATOR

MRH
867

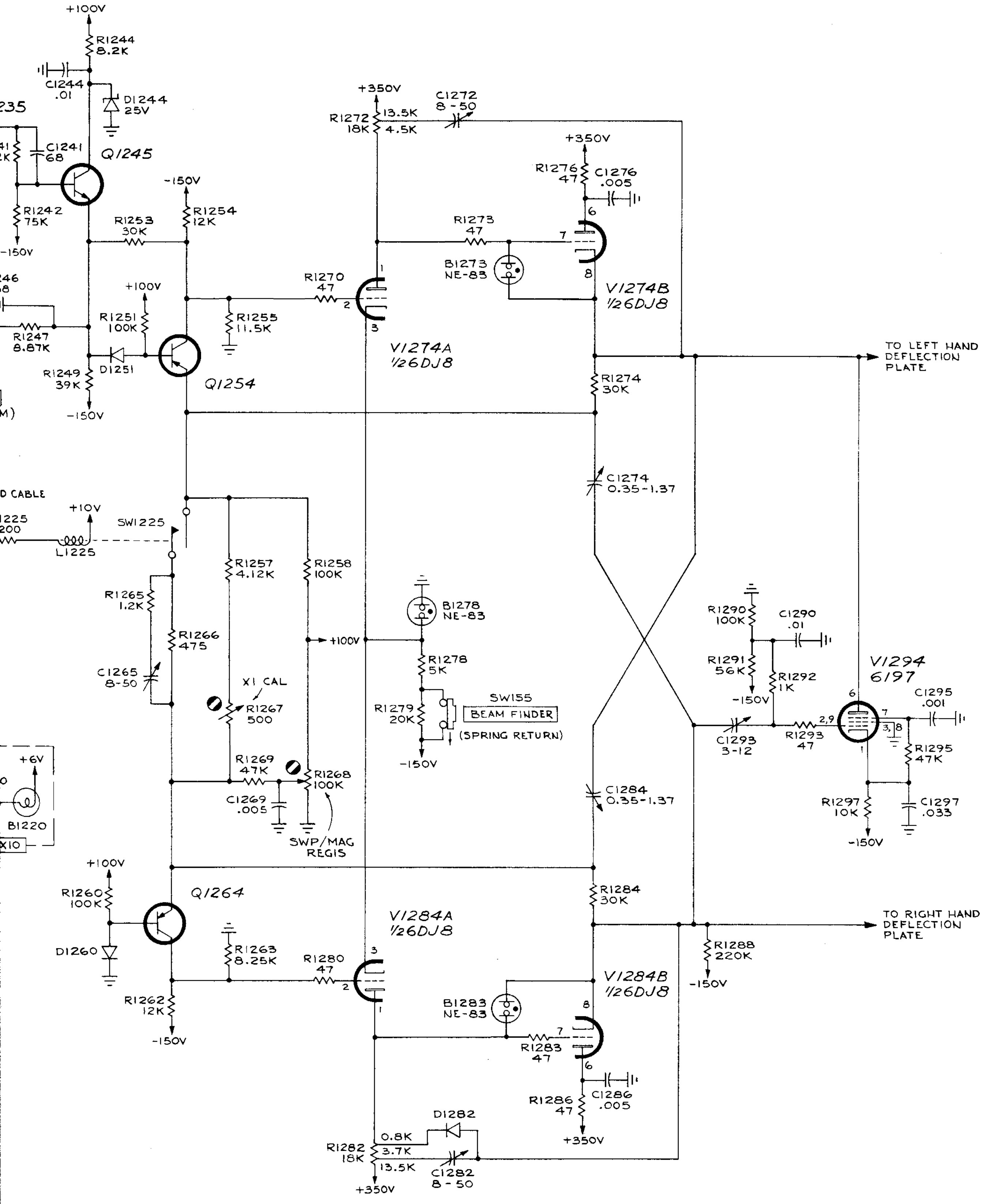
A

LOWER BEAM HORIZONTAL AMPLIFIER ⑫

S/N 2000-UP


B SWEEP FROM R883
7
+100V
R1232 12K
Q1235
+100V
R1244 8.2K
C1244 .01
D1244 25V
R1231 390K
R1241 12K
C1241 68
Q1245
R1230 100
R1234 39
R1242 75K
-150V
R1253 30K
C1246 68
+100V
R1251 100K
R1237 68.1K
X10 CAL
R1246 2.5K
R1247 8.87K
R1236A 50K
(COARSE)
D1251
R1249 39K
SW775
LOWER BEAM DISPLAY
POSITION
(LOWER BEAM)
(VERNIER)
R1236B 50K
R1239 432K
** TWO WIRE SHIELDED CABLE
+225V
R1215 18K
C1215 4.5-25
R1216 49.9K
C1217 2.7
R1217 4.7M
R1218 150K
B
EXT
RIGHT PLUG-IN
+10V
R1225 200
L1225
SW1225
R1265 1.2K
R1266 475
C1265 8-50
+100V
R1211 220K
R1213 100
R1210 100K
EXT HORIZ DC BAL
R1212 3.3K
C1212 .005
V1204B 1/2 6DJ8
+6V
R1220 39
B1220
X10
LOWER BEAM EXT HORIZ VAR 1-10
R1208 10K
R1207 33K
R1205 200
R1206 33K
+100V
R1260 100K
D1260
V1204A 1/2 6DJ8
*X1 DETAILS
R1200B 900K
C1200B 3-12
R1200D 111K
C1200D 68
LOWER BEAM EXT HORIZ IN
J1200
*X1
X10
R1203 1K
R1202 1M
R1262 12K
SW1220
DISPLAY MAG
SEE PARTS LIST FOR SEMICONDUCTOR TYPES
REFERENCE DIAGRAM:
7 B SWEEP GENERATOR

B



SEE PARTS LIST FOR SEMICONDUCTOR TYPES

REFERENCE DIAGRAM:

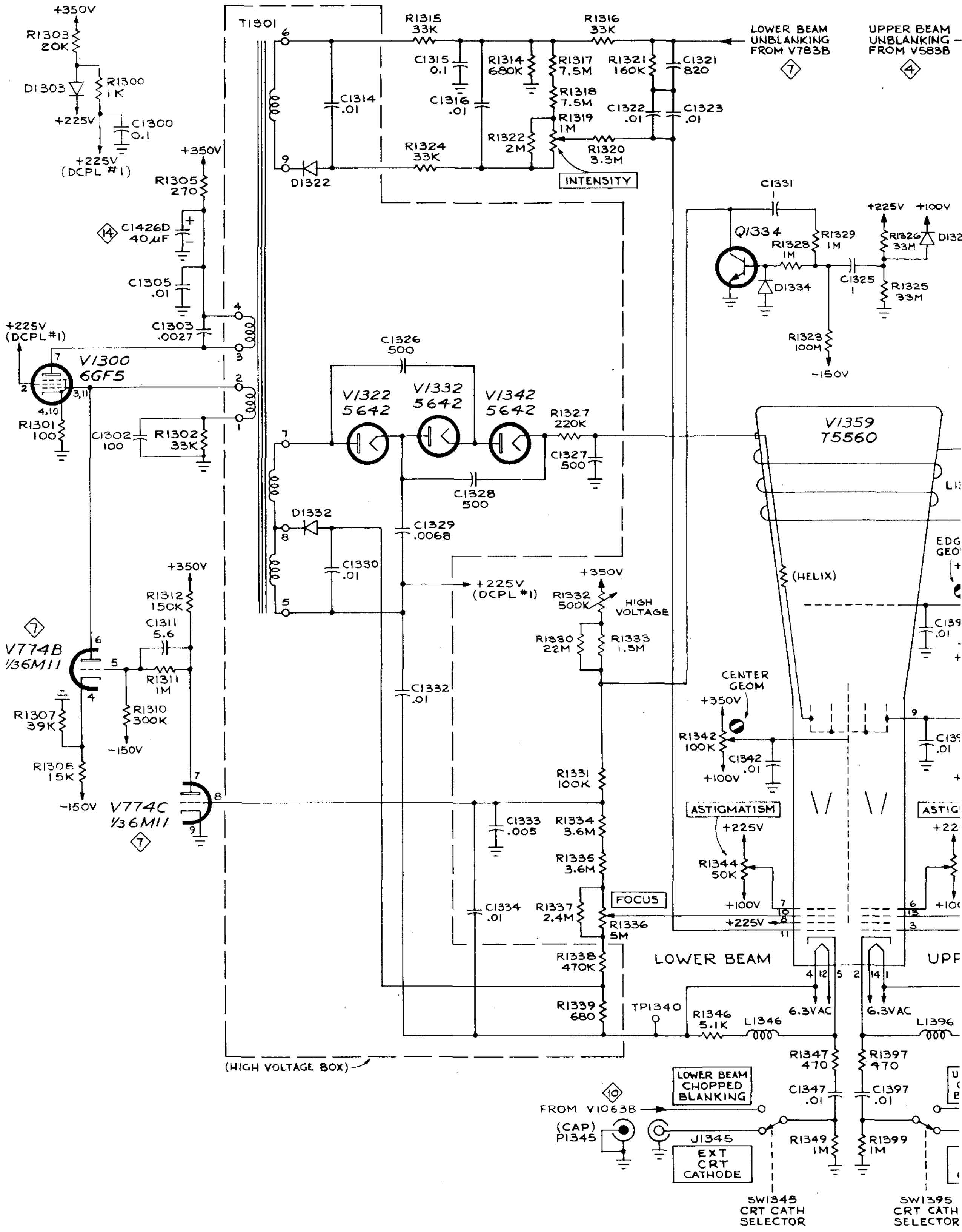
⟨7⟩ B SWEEP GENERATOR

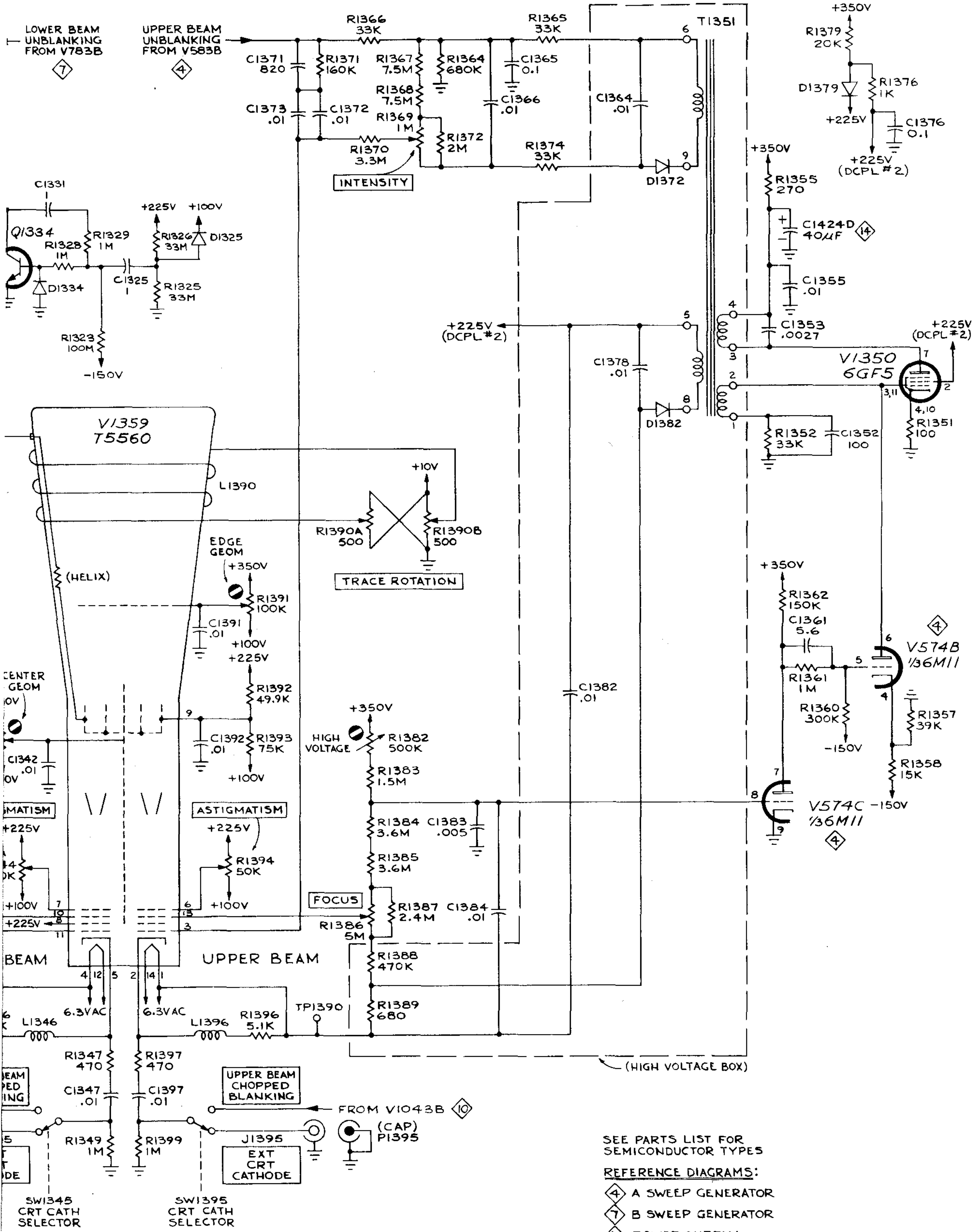
MRH 666

B

LOWER BEAM HORIZONTAL AMPLIFIER ⟨12⟩

S/N 100-1999


+350V
R1303 20K
D1303
R1300 1K
+225V
C1300 0.1
+225V (DCPL #1)
+350V
R1305 270
C1426D 40µF
C1305 .01
C1303 .0027
+225V (DCPL#1)
V1300 6GF5
R1301 100
C1302 100
R1302 33K
T1301
C1314 .01
D1322
R1315 33K
C1315 0.1
C1316 .01
R1314 680K
R1324 33K
R1317 7.5M
R1318 7.5M
R1319 1M
R1322 2M
R1320 3.3M
INTENSITY
R1316 33K
R1321 160K
C1321 820
C1322 .01
C1323 .01
LOWER BEAM UNBLANKING FROM V783B
UPPER BEAM UNBLANKING FROM V583B
C1331
Q1334
R1328 1M
R1329 1M
D1334
C1325 1
R1326 33M
R1325 33M
R1323 100M
-150V
+225V +100V
C1326 500
V1322 5642
V1332 5642
V1342 5642
R1327 220K
C1327 500
C1328 500
D1332
C1329 .0068
C1330 .01
+225V (DCPL #1)
+350V
R1332 500K
HIGH VOLTAGE
R1330 22M
R1333 1.5M
V1359 T5560
(HELIX)
+350V
R1312 150K
C1311 5.6
R1311 1M
V774B 1/3 6M11
R1310 300K
-150V
R1307 39K
R1308 15K
-150V
V774C 1/3 6M11
C1332 .01
C1333 .005
C1334 .01
R1331 100K
R1334 3.6M
R1335 3.6M
R1337 2.4M
FOCUS
R1336 5M
R1338 470K
R1339 680
TP1340
R1346 5.1K
L1346
CENTER GEOM
+350V
R1342 100K
C1342 .01
+100V
ASTIGMATISM
+225V
R1344 50K
+100V
+225V
LOWER BEAM
6.3VAC
6.3VAC
L1396
R1347 470
R1397 470
C1347 .01
C1397 .01
R1349 1M
R1399 1M
(HIGH VOLTAGE BOX)
LOWER BEAM CHOPPED BLANKING
FROM V1063B
(CAP) P1345
J1345
EXT CRT CATHODE
SW1345 CRT CATH SELECTOR
SW1395 CRT CATH SELECTOR



SEE PARTS LIST FOR
SEMICONDUCTOR TYPES

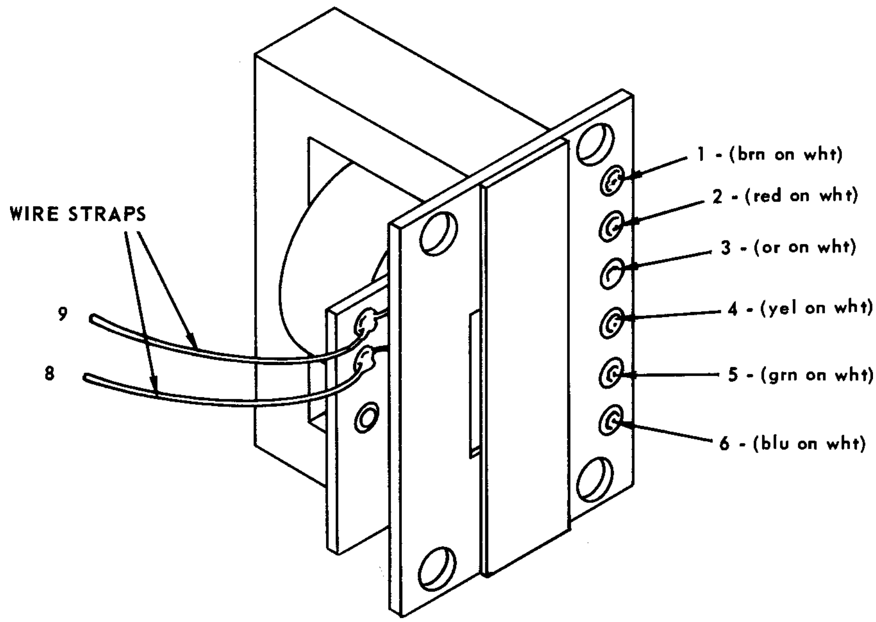
REFERENCE DIAGRAMS:

4 A SWEEP GENERATOR
7 B SWEEP GENERATOR
14 POWER SUPPLY
10 ALTERNATE TRACE LOGIC & BLANKING

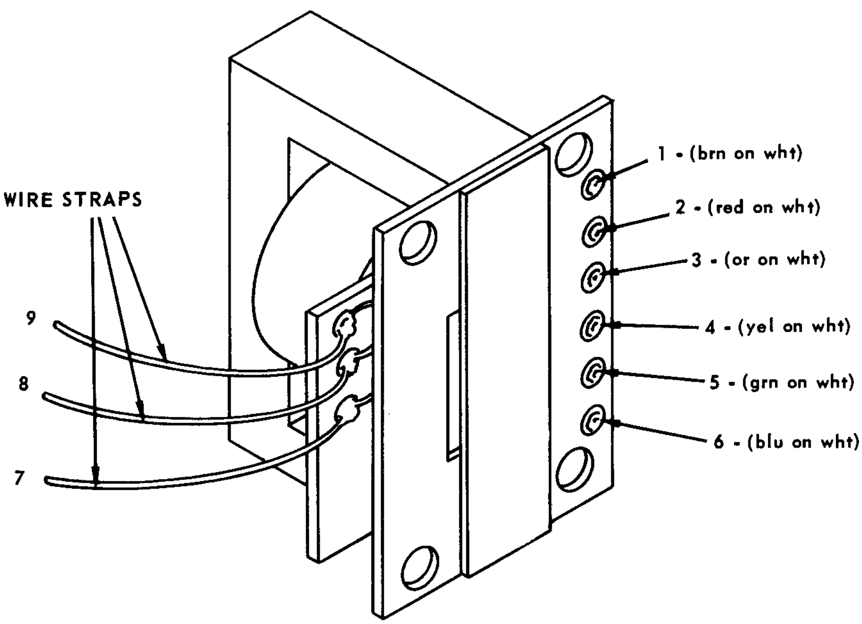
MRH
867

A

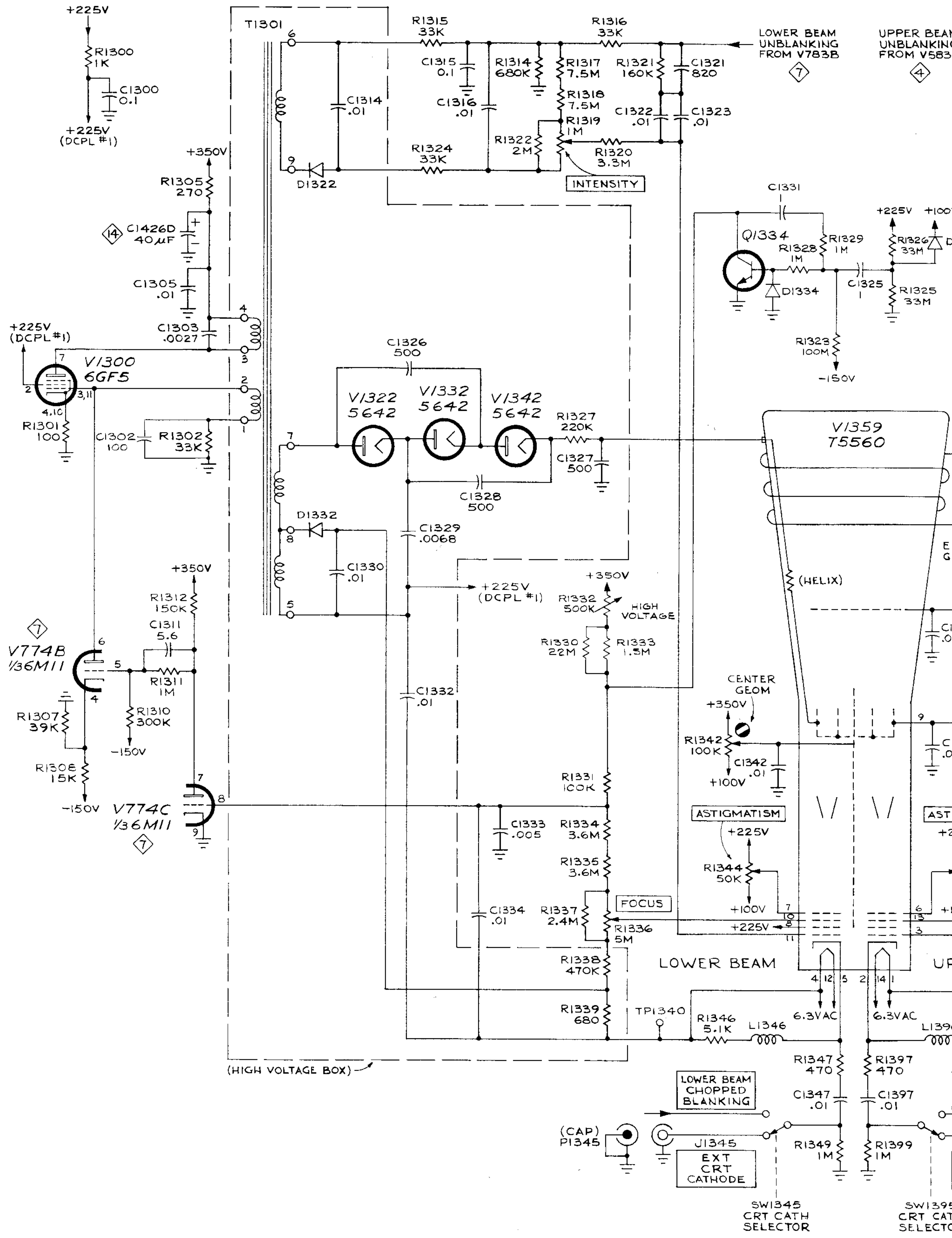
CRT CIRCUIT 13
S/N 2000-UP



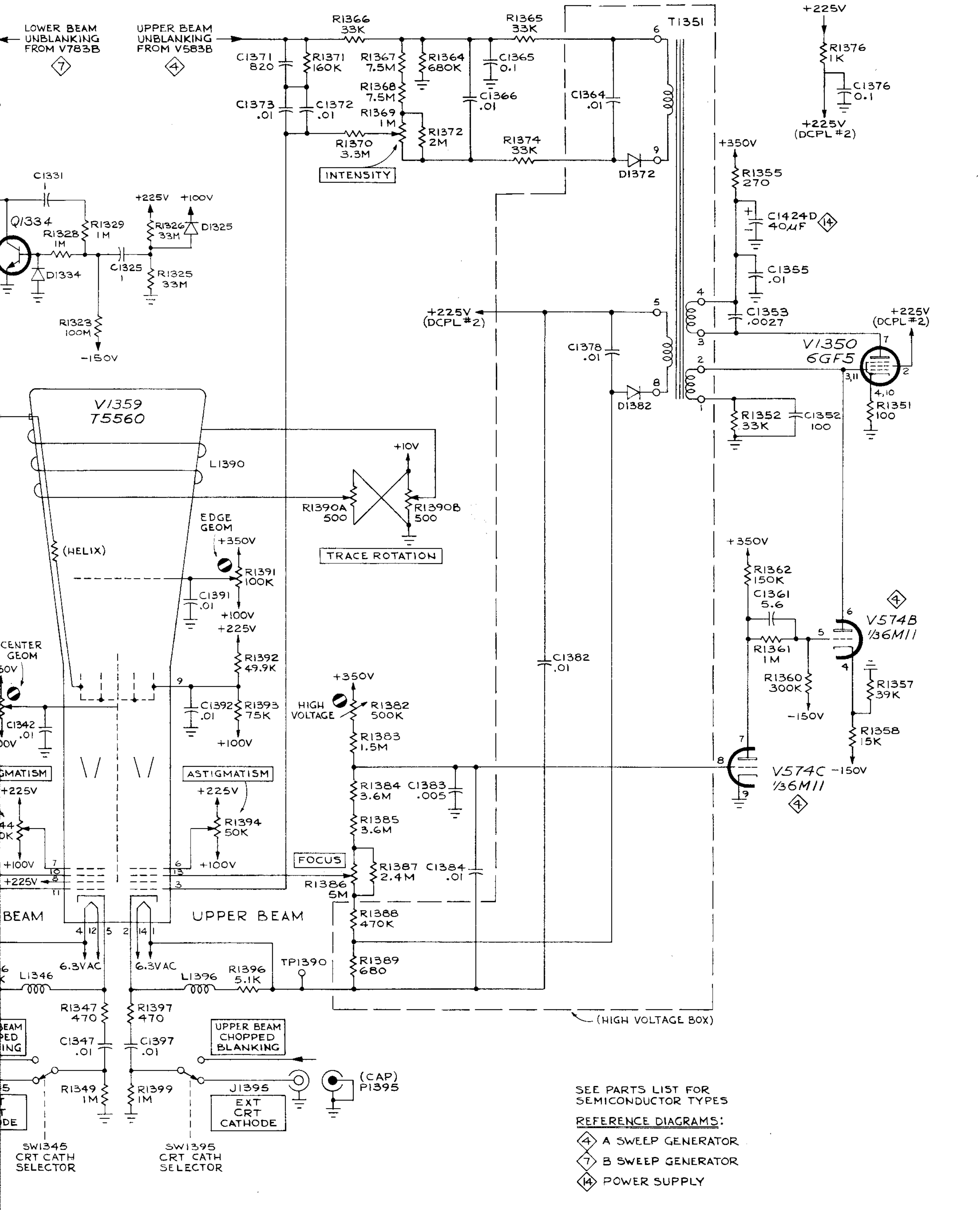
T1351
(Upper Beam)
TRANSFORMER DETAILS



T1301
(Lower Beam)
TRANSFORMER DETAILS



+225V
R1300 1K
C1300 0.1
+225V (DCPL #1)
T1301
R1315 33K
R1316 33K
LOWER BEAM UNBLANKING FROM V783B
UPPER BEAM UNBLANKING FROM V583
C1315 0.1
R1314 680K
R1317 7.5M
R1321 160K
C1321 820
C1314 .01
C1316 .01
R1318 7.5M
C1322 .01
C1323 .01
R1319 1M
R1322 2M
R1320 3.3M
R1324 33K
D1322
INTENSITY
+350V
R1305 270
C1426D 40µF
C1305 .01
C1303 .0027
+225V (DCPL #1)
V1300 6GF5
R1301 100
C1302 100
R1302 33K
C1331
Q1334
R1329 1M
R1328 1M
R1326 33M
R1325 33M
D1334
C1325 1
R1323 100M
-150V
C1326 500
V1322 5642
V1332 5642
V1342 5642
R1327 220K
C1327 500
C1328 500
V1359 T5560
D1332
C1329 .0068
C1330 .01
+225V (DCPL #1)
+350V
R1332 500K
HIGH VOLTAGE
(HELIX)
R1330 22M
R1333 1.5M
+350V
R1312 150K
C1311 5.6
V774B 1/3 6M11
R1311 1M
R1310 300K
-150V
R1307 39K
R1308 15K
-150V
C1332 .01
CENTER GEOM
R1342 100K
C1342 .01
+100V
V774C 1/3 6M11
R1331 100K
C1333 .005
R1334 3.6M
ASTIGMATISM
+225V
R1335 3.6M
R1344 50K
FOCUS
C1334 .01
R1337 2.4M
R1336 5M
+100V
+225V
R1338 470K
LOWER BEAM
R1339 680
TP1340
R1346 5.1K
L1346
6.3VAC
6.3VAC
(HIGH VOLTAGE BOX)
R1347 470
R1397 470
LOWER BEAM CHOPPED BLANKING
C1347 .01
C1397 .01
(CAP) P1345
J1345
EXT CRT CATHODE
R1349 1M
R1399 1M
SW1345 CRT CATH SELECTOR



SEE PARTS LIST FOR SEMICONDUCTOR TYPES

REFERENCE DIAGRAMS:

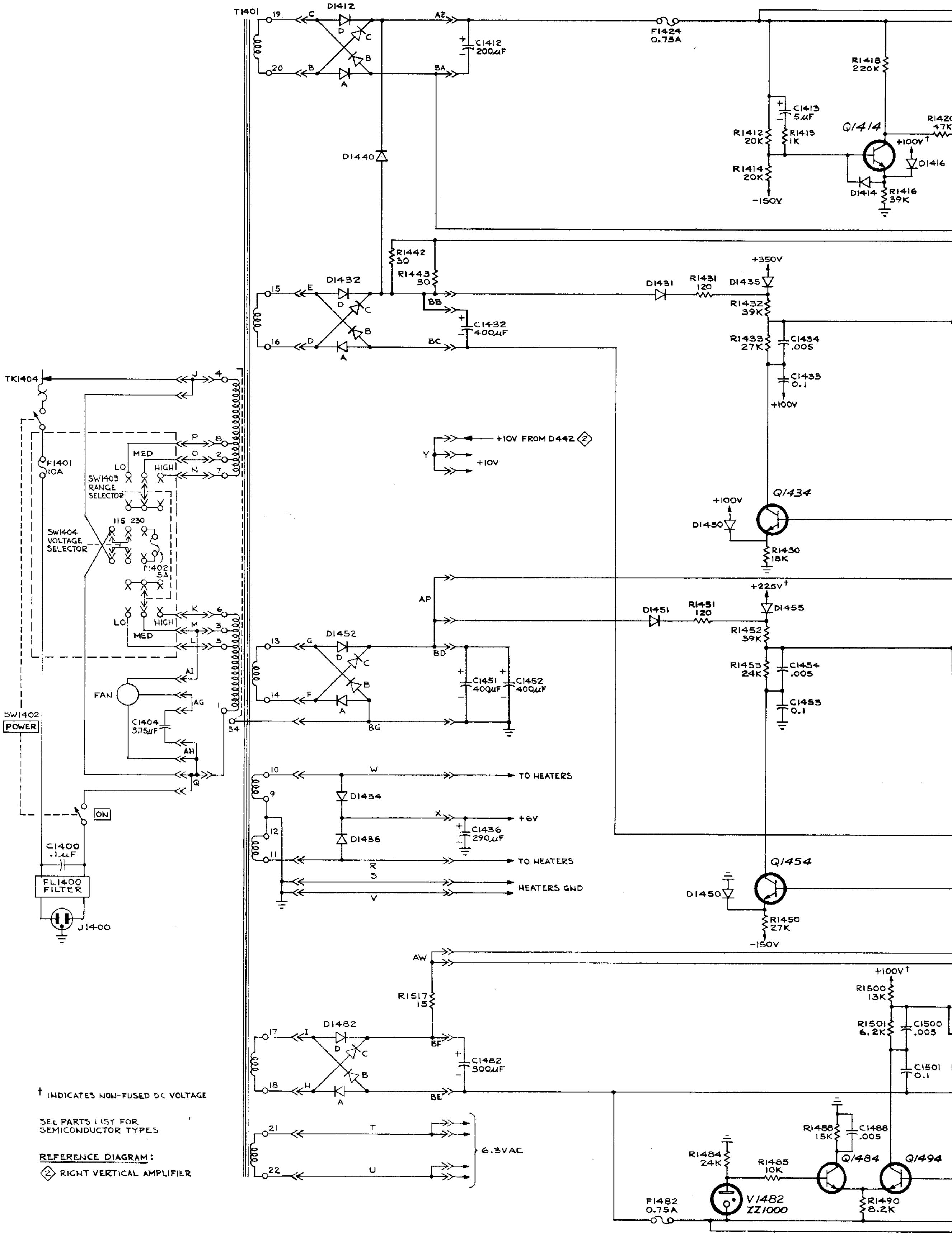
- 4 A SWEEP GENERATOR
- 7 B SWEEP GENERATOR
- 14 POWER SUPPLY

MRH
966

CRT CIRCUIT 13

S/N 100-1999

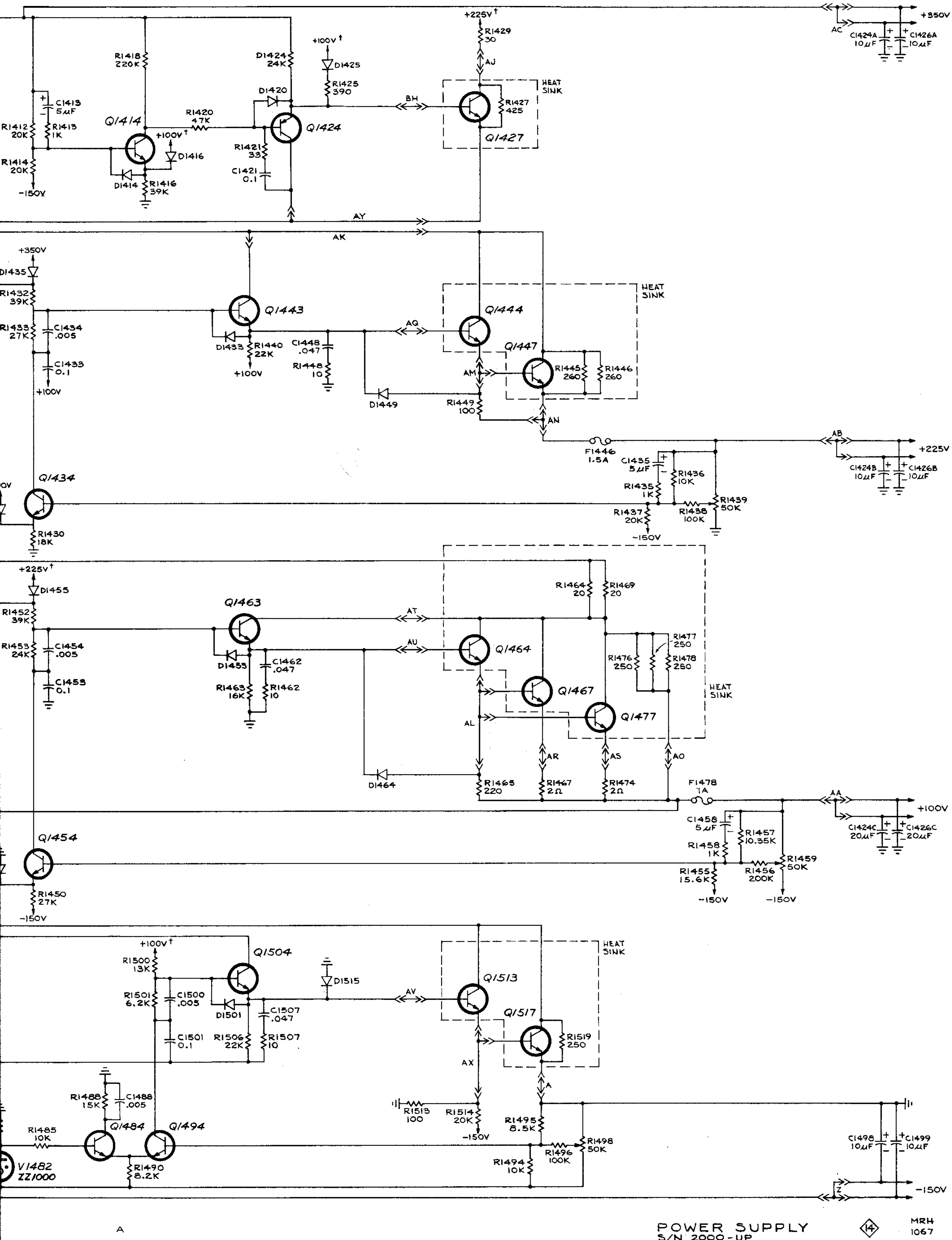
c

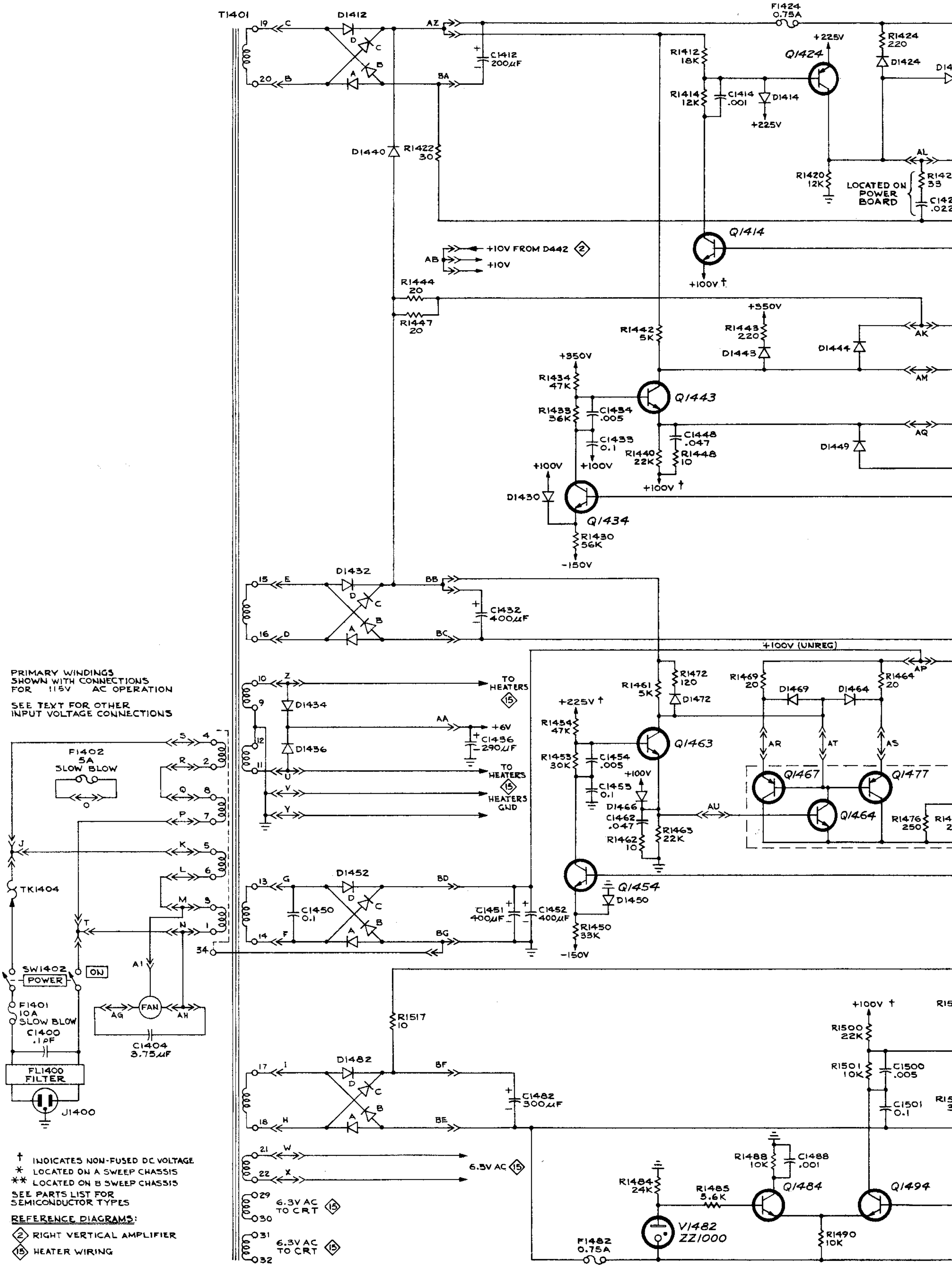


† INDICATES NON-FUSED DC VOLTAGE

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

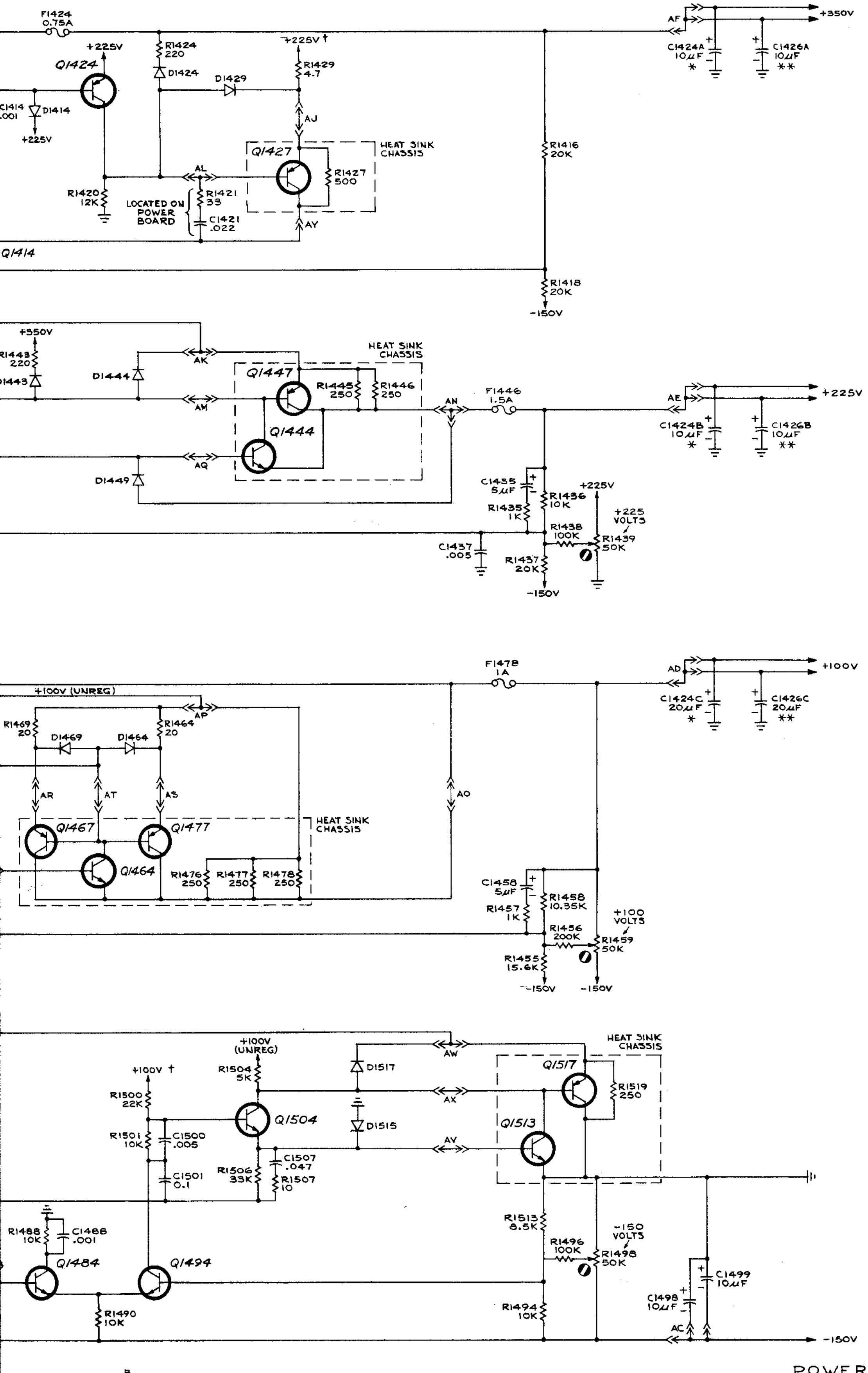
REFERENCE DIAGRAM:
2 RIGHT VERTICAL AMPLIFIER


POWER SUPPLY
S/N 2000-UP
MRH
1067



† INDICATES NON-FUSED DC VOLTAGE
* LOCATED ON A SWEEP CHASSIS
** LOCATED ON B SWEEP CHASSIS
SEE PARTS LIST FOR SEMICONDUCTOR TYPES

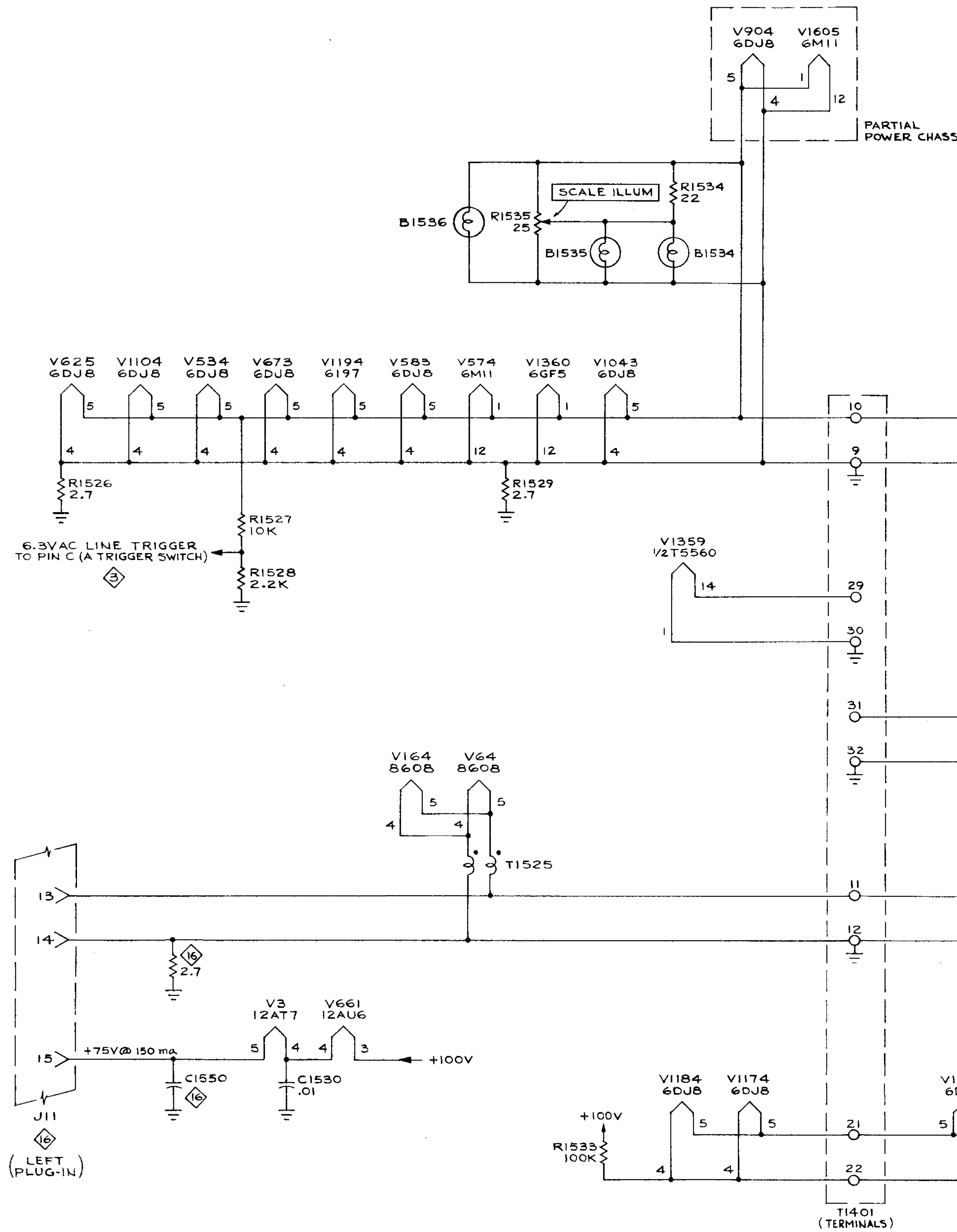
REFERENCE DIAGRAMS:
② RIGHT VERTICAL AMPLIFIER
⑮ HEATER WIRING



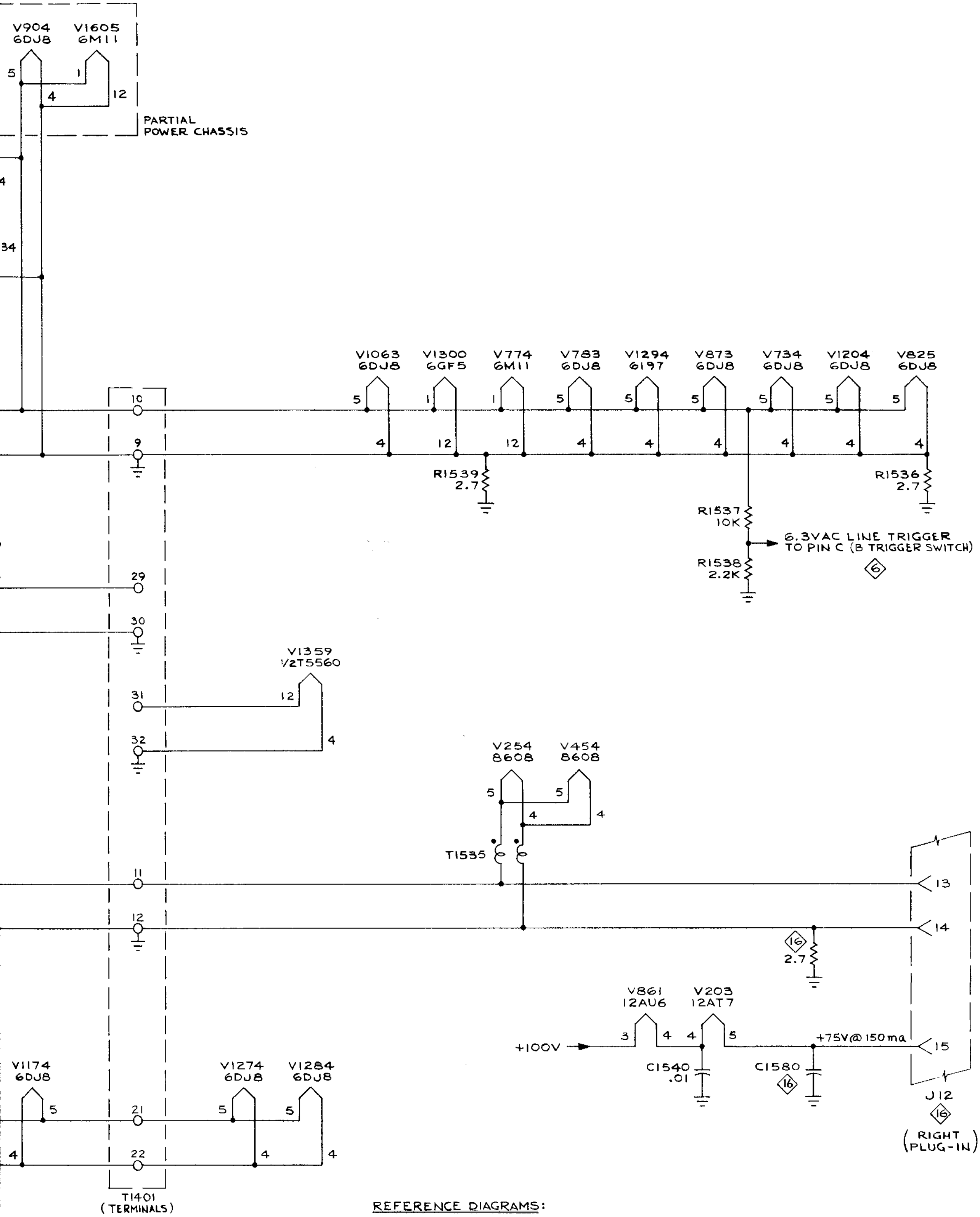
MRH
1067

POWER SUPPLY ⑭

S/N 100-1999



V904
6DJ8
V1605
6M11
PARTIAL
POWER CHASS
SCALE ILLUM
R1534
22
R1535
25
B1536
B1535
B1534
V625
6DJ8
V1104
6DJ8
V534
6DJ8
V673
6DJ8
V1194
6197
V583
6DJ8
V574
6M11
V1360
6GF5
V1043
6DJ8
R1526
2.7
R1529
2.7
R1527
10K
6.3VAC LINE TRIGGER
TO PIN C (A TRIGGER SWITCH)
R1528
2.2K
V1359
1/2T5560
V164
8608
V64
8608
T1525
J11
(LEFT PLUG-IN)
+75V@ 150 ma
V3
12AT7
V661
12AU6
+100V
C1550
C1530
.01
V1184
6DJ8
V1174
6DJ8
R1533
100K
T1401
(TERMINALS)



REFERENCE DIAGRAMS:

3 A SWEEP TRIGGER

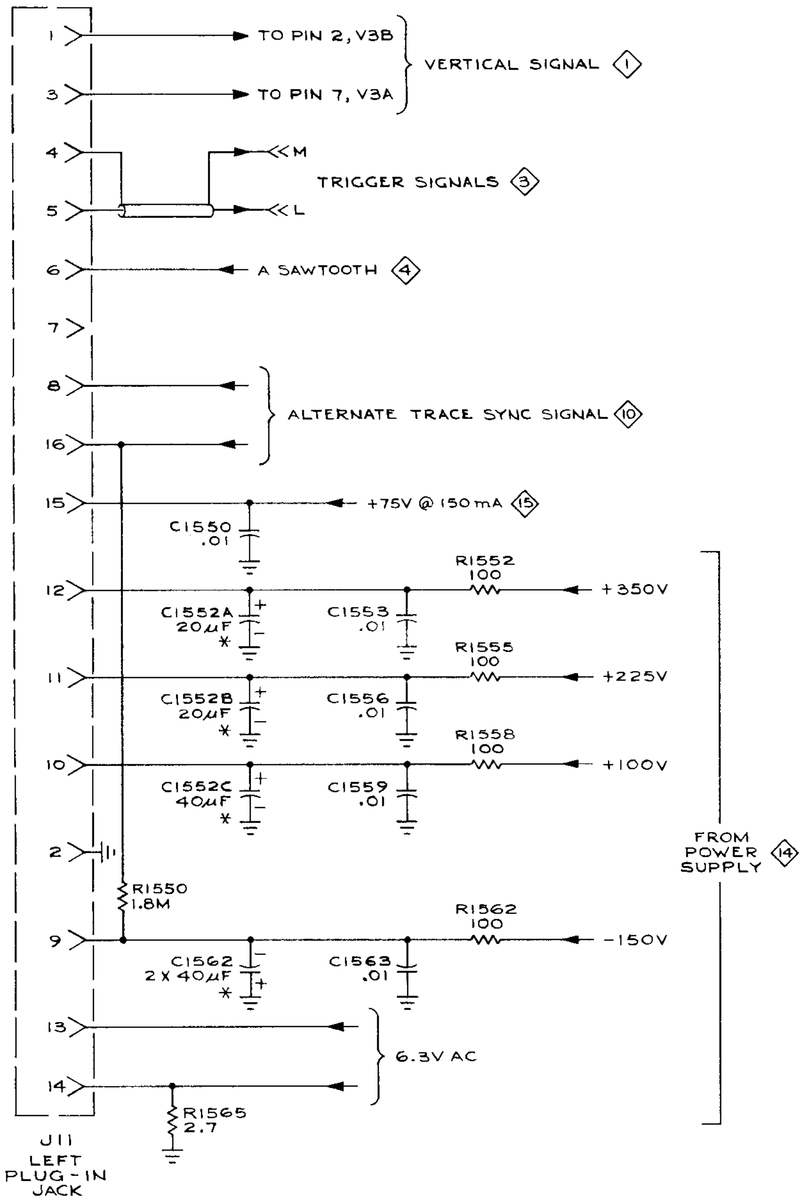
6 B SWEEP TRIGGER

16 PLUG-IN JACK DETAILS

MRH
666

B

HEATER WIRING 15

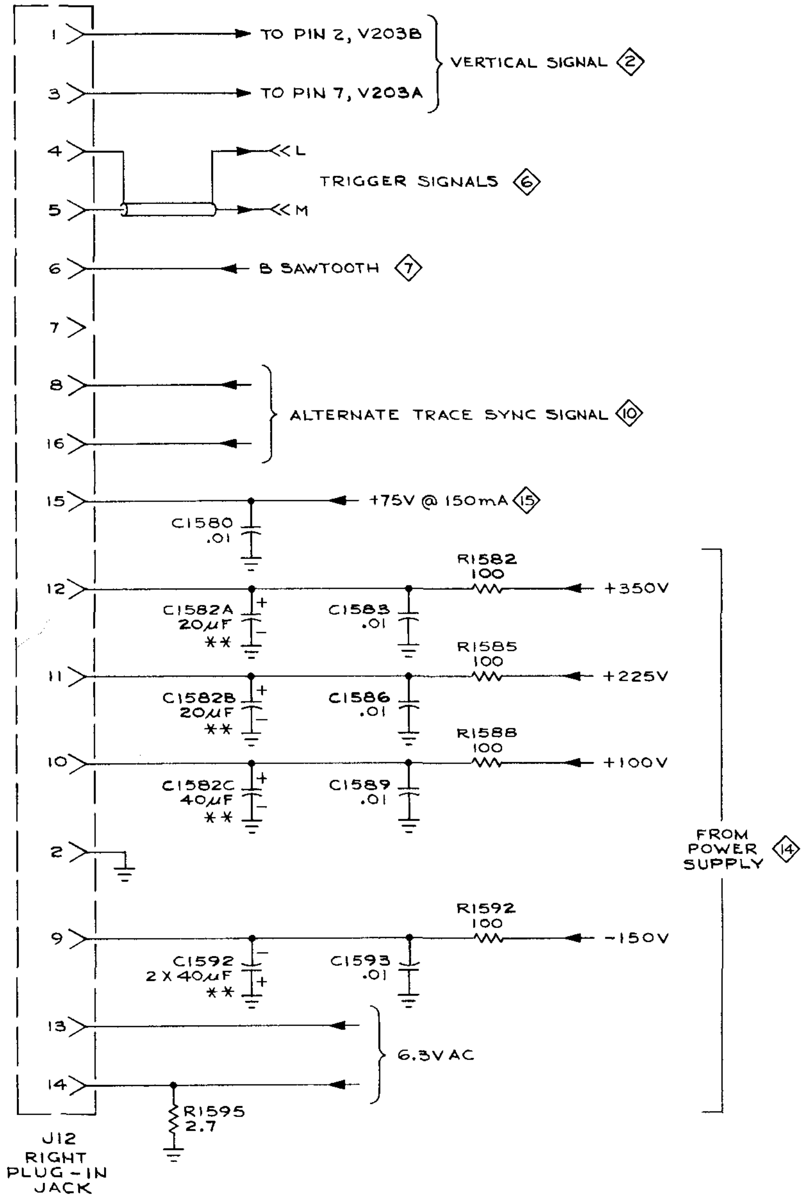


*LOCATED ON LEFT VERTICAL CHASSIS

REFERENCE DIAGRAMS:

1 LEFT VERTICAL AMPLIFIER
2 RIGHT VERTICAL AMPLIFIER
3 A SWEEP TRIGGER
4 A SWEEP GENERATOR
6 B SWEEP TRIGGER
7 B SWEEP GENERATOR
10 ALTERNATE TRACE LOGIC & B
14 POWER SUPPLY
15 HEATER WIRING

⑭



**LOCATED ON RIGHT VERTICAL CHASSIS

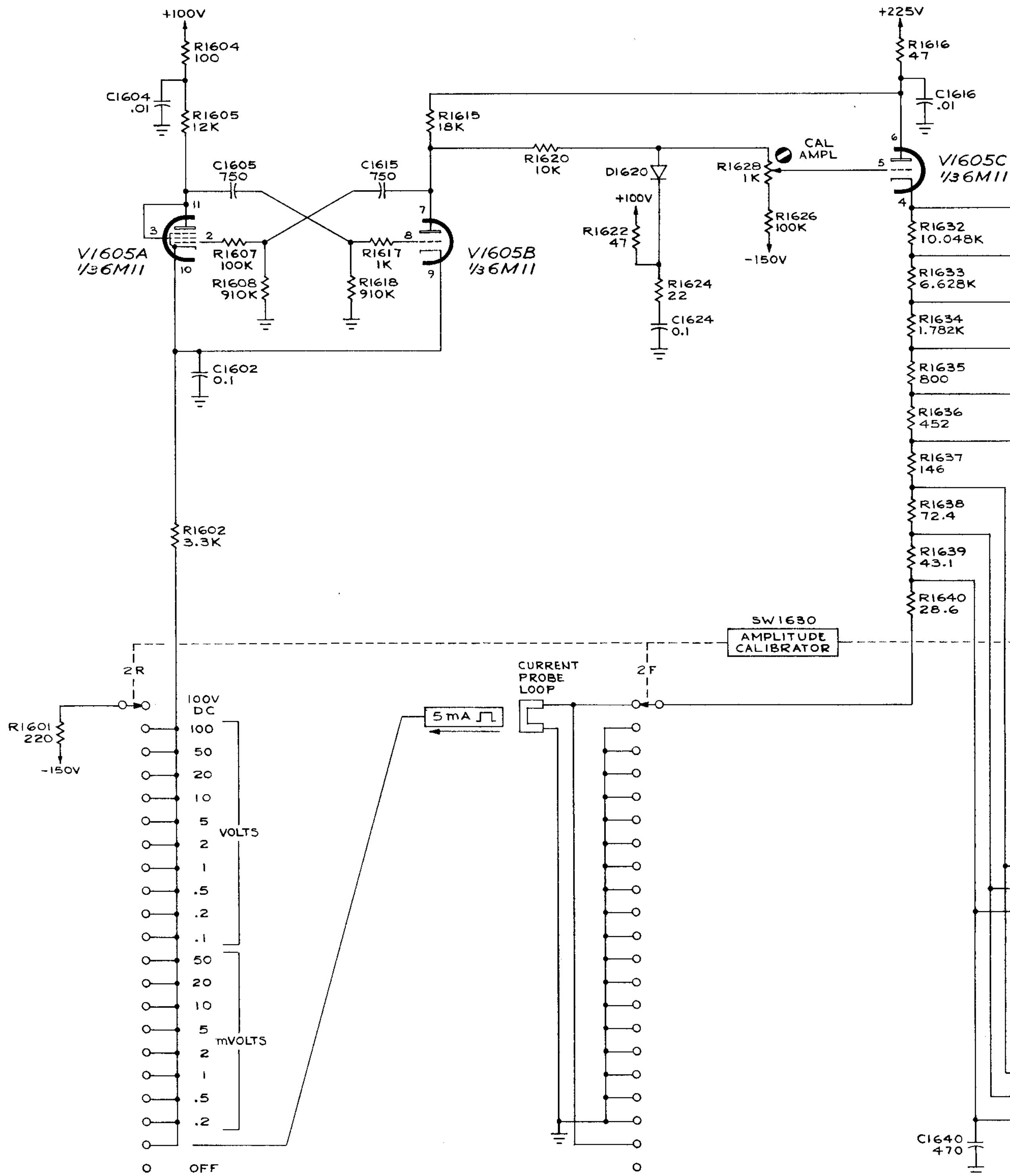
REFERENCE DIAGRAMS:

① LEFT VERTICAL AMPLIFIER
② RIGHT VERTICAL AMPLIFIER
③ A SWEEP TRIGGER
④ A SWEEP GENERATOR
⑥ B SWEEP TRIGGER
⑦ B SWEEP GENERATOR
⑩ ALTERNATE TRACE LOGIC & BLANKING
⑭ POWER SUPPLY
⑮ HEATER WIRING

MRH
666

B

PLUG-IN JACK DETAILS ⑯


+100V
R1604 100
C1604 .01
R1605 12K
C1605 750
C1615 750
R1615 18K
R1607 100K
R1608 910K
R1617 1K
R1618 910K
V1605A 1/3 6M11
V1605B 1/3 6M11
C1602 0.1
R1602 3.3K
R1620 10K
D1620
+100V
R1622 47
R1624 22
C1624 0.1
R1628 1K
CAL AMPL
R1626 100K
-150V
+225V
R1616 47
C1616 .01
V1605C 1/3 6M11
R1632 10.048K
R1633 6.628K
R1634 1.782K
R1635 800
R1636 452
R1637 146
R1638 72.4
R1639 43.1
R1640 28.6
SW1630 AMPLITUDE CALIBRATOR
2R
2F
R1601 220
-150V
100V DC
100
50
20
10
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2
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.5
.2
.1
VOLTS
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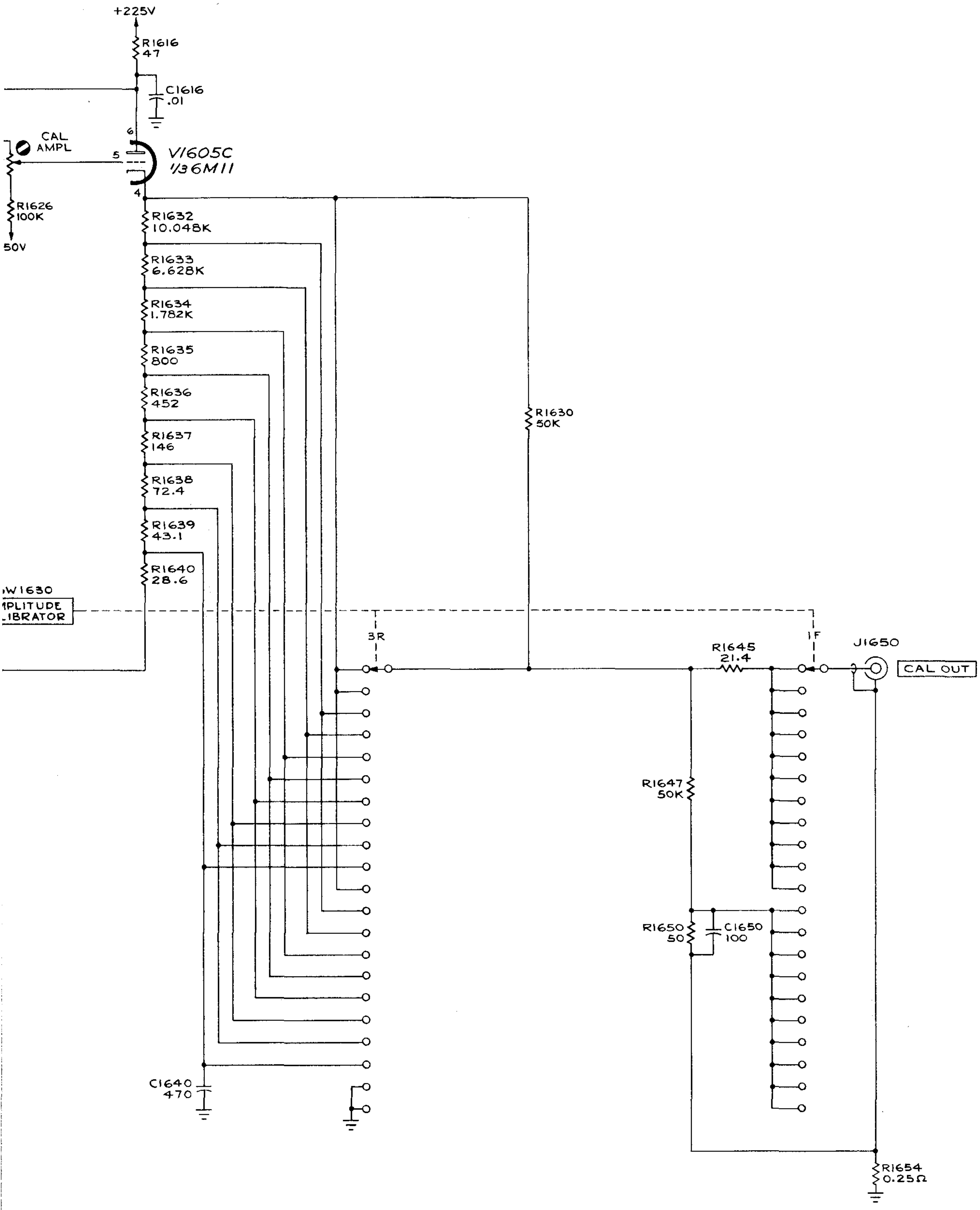
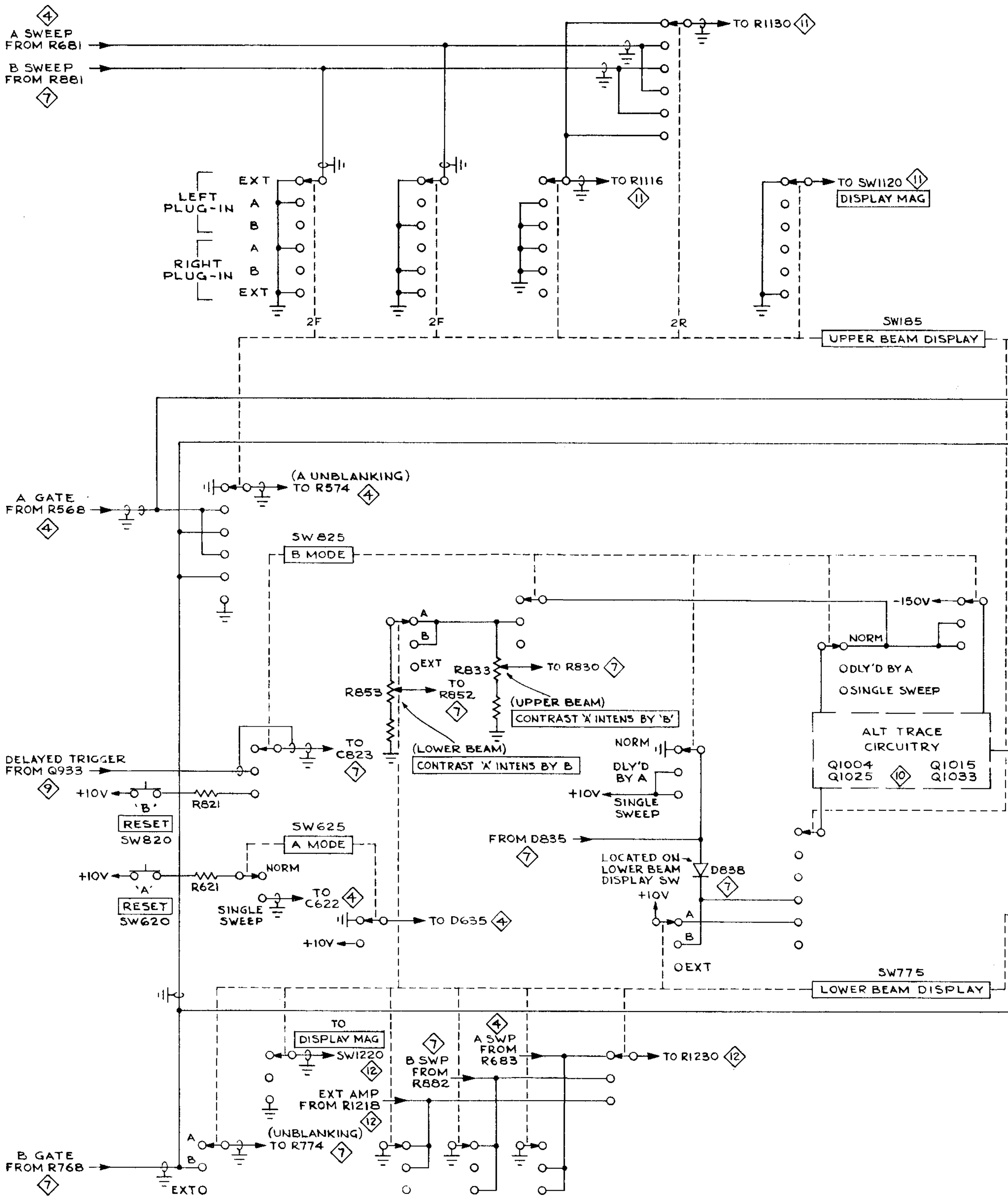
.5
.2
mVOLTS
OFF
5mA
CURRENT PROBE LOOP
C1640 470

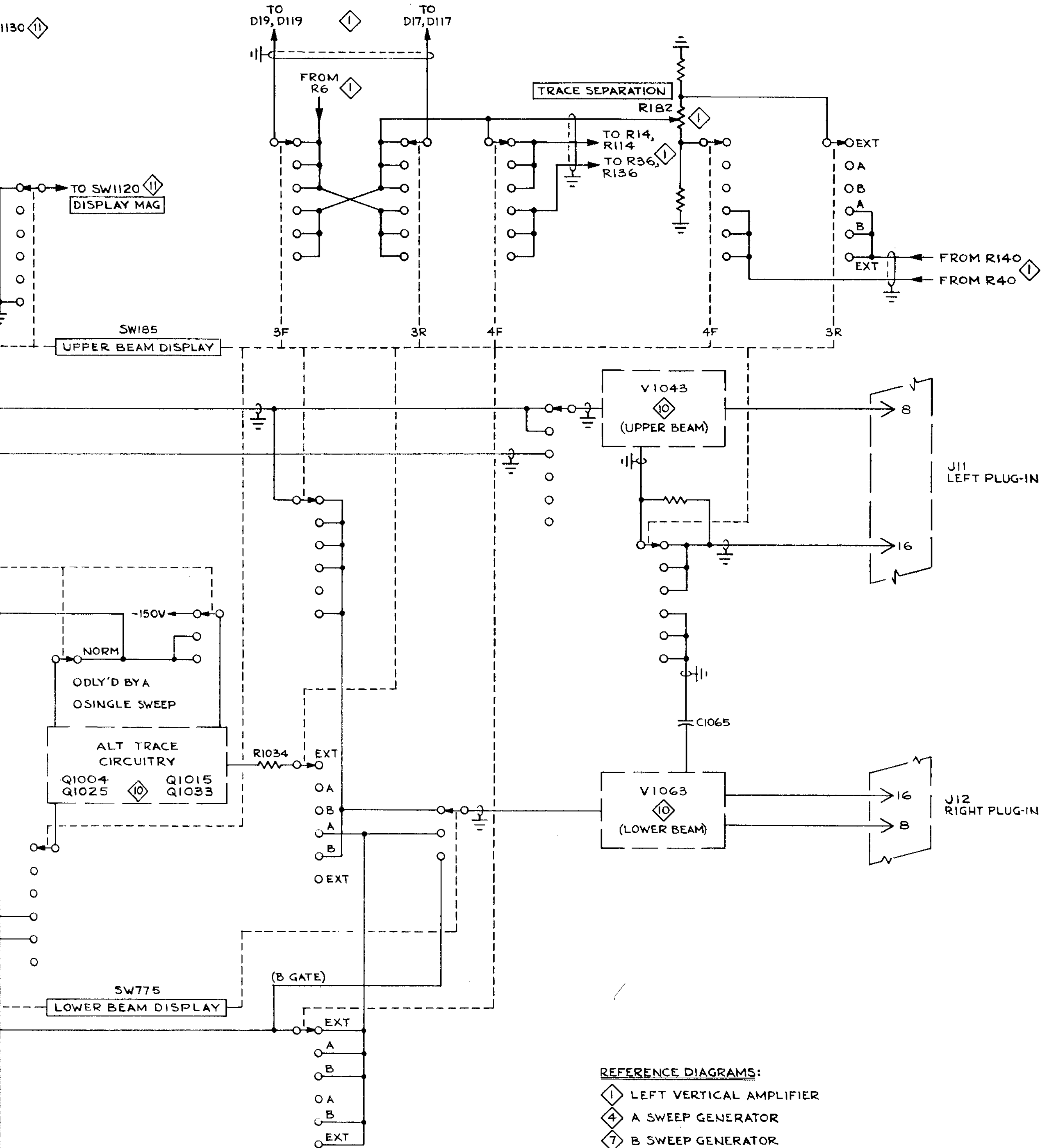


MRH
666

CALIBRATOR 17

B


A SWEEP FROM R681
B SWEEP FROM R881
TO R1130
LEFT PLUG-IN
RIGHT PLUG-IN
EXT
A
B
TO R1116
TO SW1120
DISPLAY MAG
2F
2R
SW185
UPPER BEAM DISPLAY
A GATE FROM R568
(A UNBLANKING) TO R574
SW 825
B MODE
-150V
NORM
DLY'D BY A
SINGLE SWEEP
R833
TO R830
TO R852
R853
(UPPER BEAM)
CONTRAST 'A' INTENS BY 'B'
(LOWER BEAM)
CONTRAST 'A' INTENS BY B
ALT TRACE CIRCUITRY
Q1004 Q1025 Q1015 Q1033
DELAYED TRIGGER FROM Q933
TO C823
+10V
'B' RESET SW820
R821
SW625
A MODE
'A' RESET SW620
R621
TO C622
TO D635
FROM D835
LOCATED ON LOWER BEAM DISPLAY SW
D838
SW775
LOWER BEAM DISPLAY
TO DISPLAY MAG SW1220
B SWP FROM R882
A SWP FROM R683
TO R1230
EXT AMP FROM R1218
(UNBLANKING) TO R774
B GATE FROM R768



REFERENCE DIAGRAMS:

- (1) LEFT VERTICAL AMPLIFIER
- (4) A SWEEP GENERATOR
- (7) B SWEEP GENERATOR
- (10) ALTERNATE TRACE LOGIC & BLANKING
- (11) UPPER BEAM HORIZONTAL AMPLIFIER
- (12) LOWER BEAM HORIZONTAL AMPLIFIER

A

HORIZONTAL DISPLAY & MODE SWITCHING (18) MRH 867

S/N 2000-UP

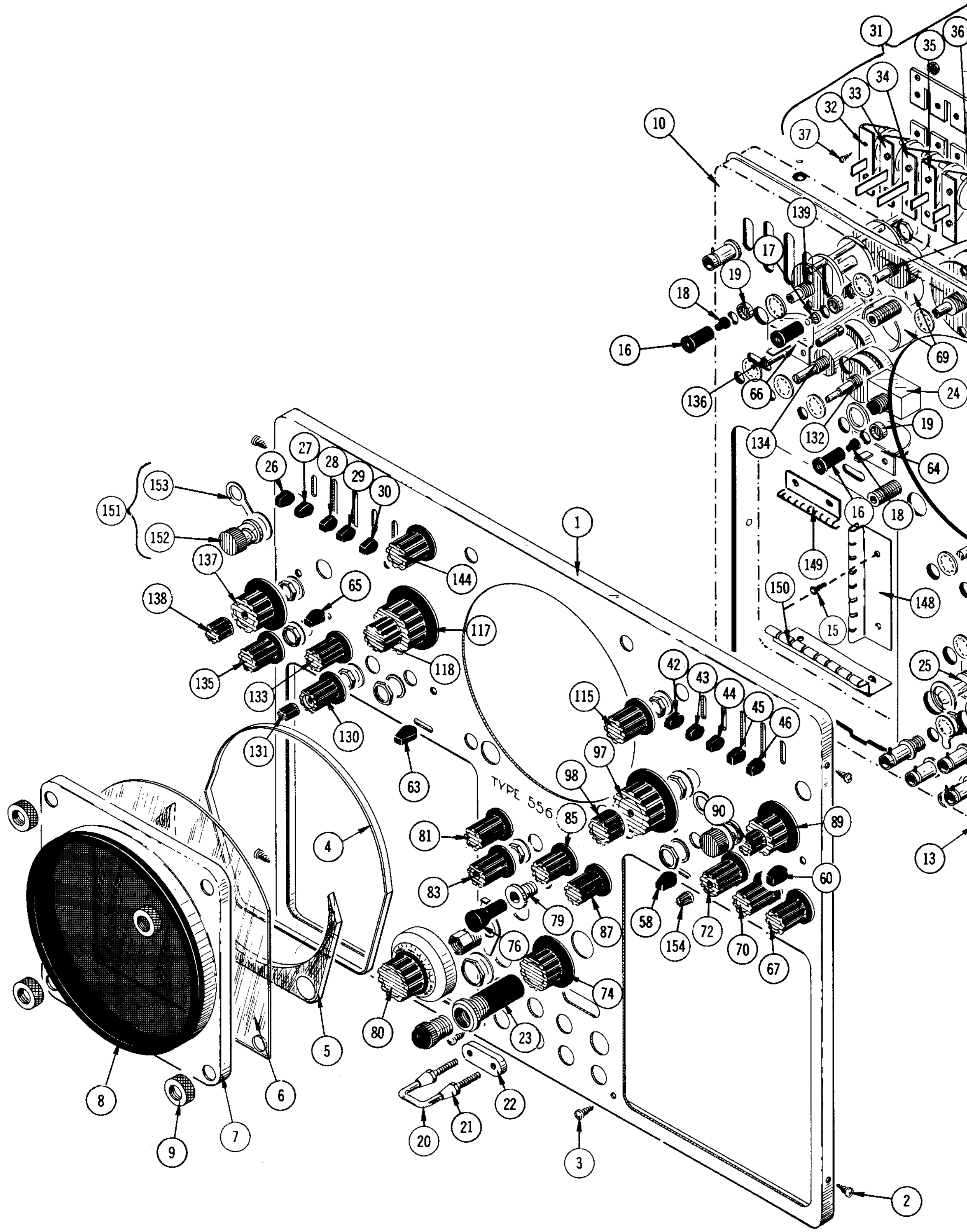


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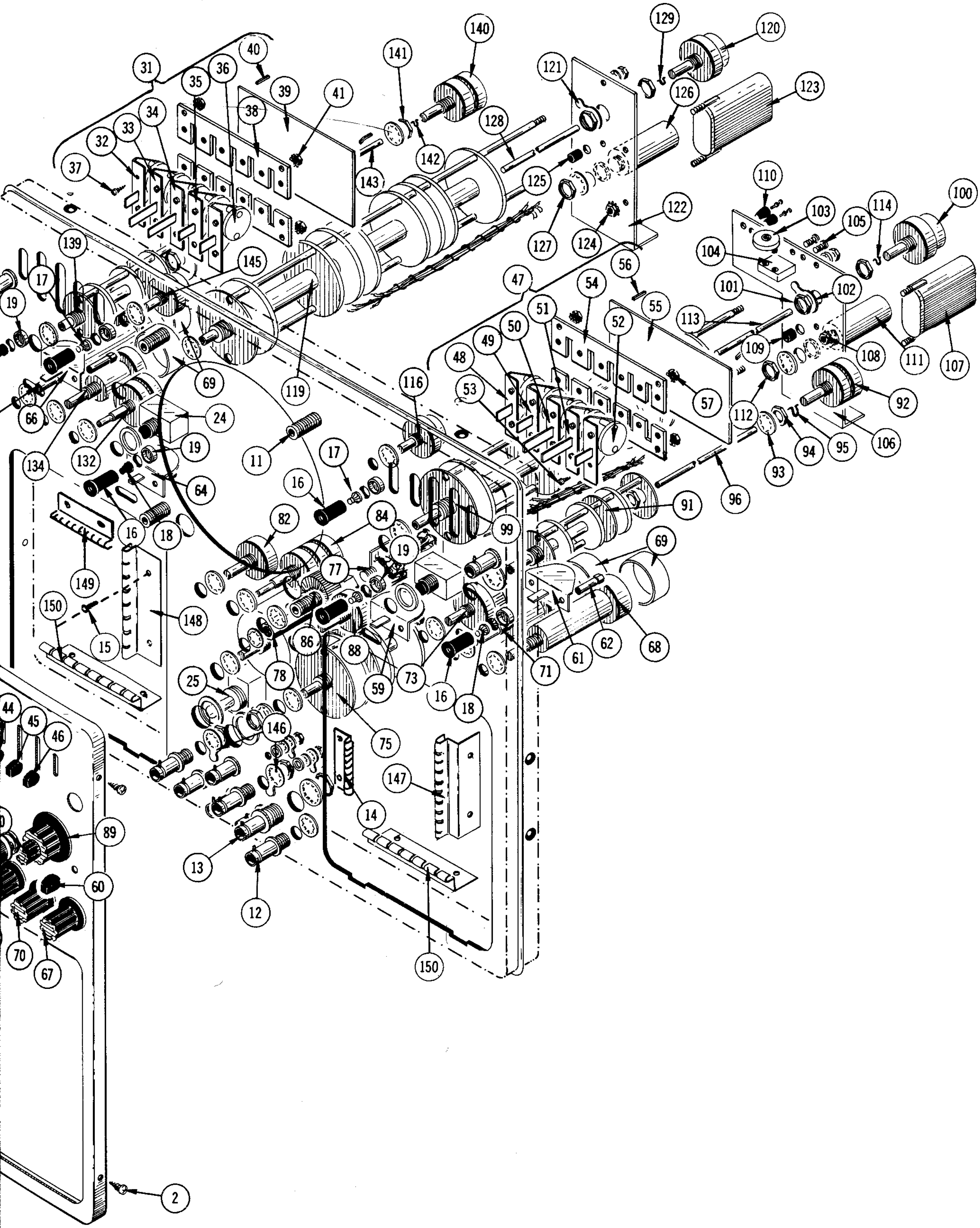
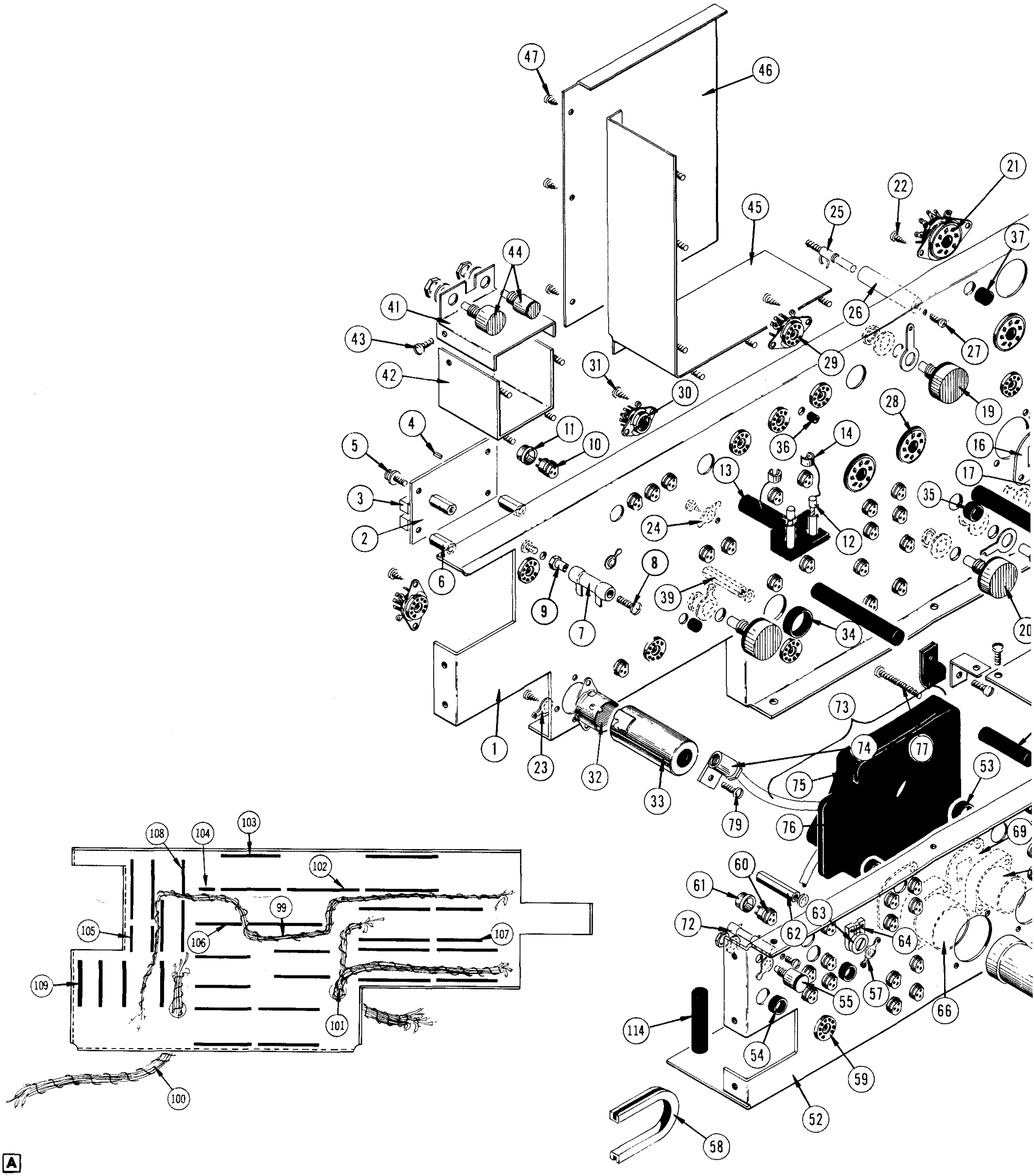
FIG. 1 FRONT & SWITCHES

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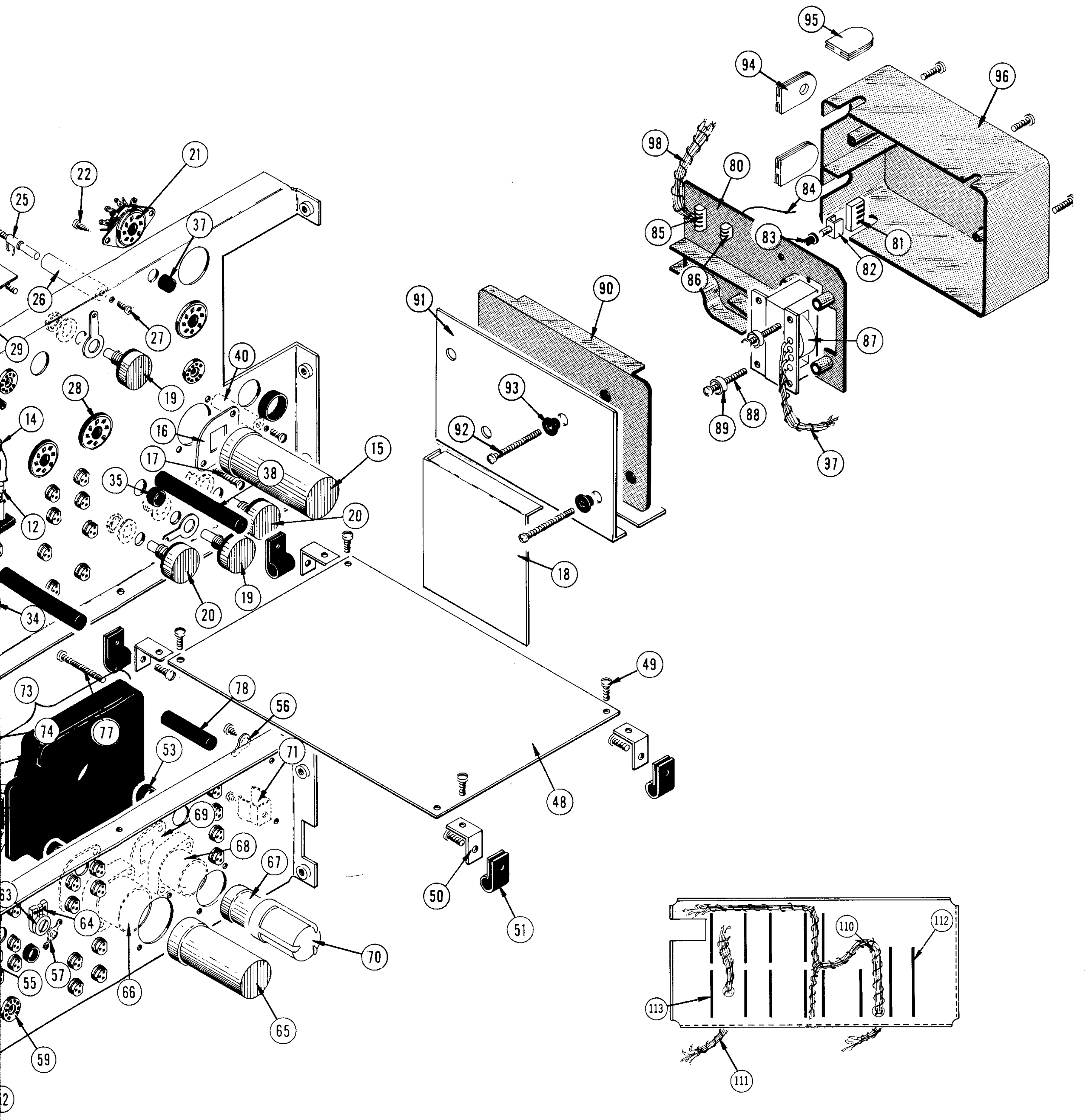
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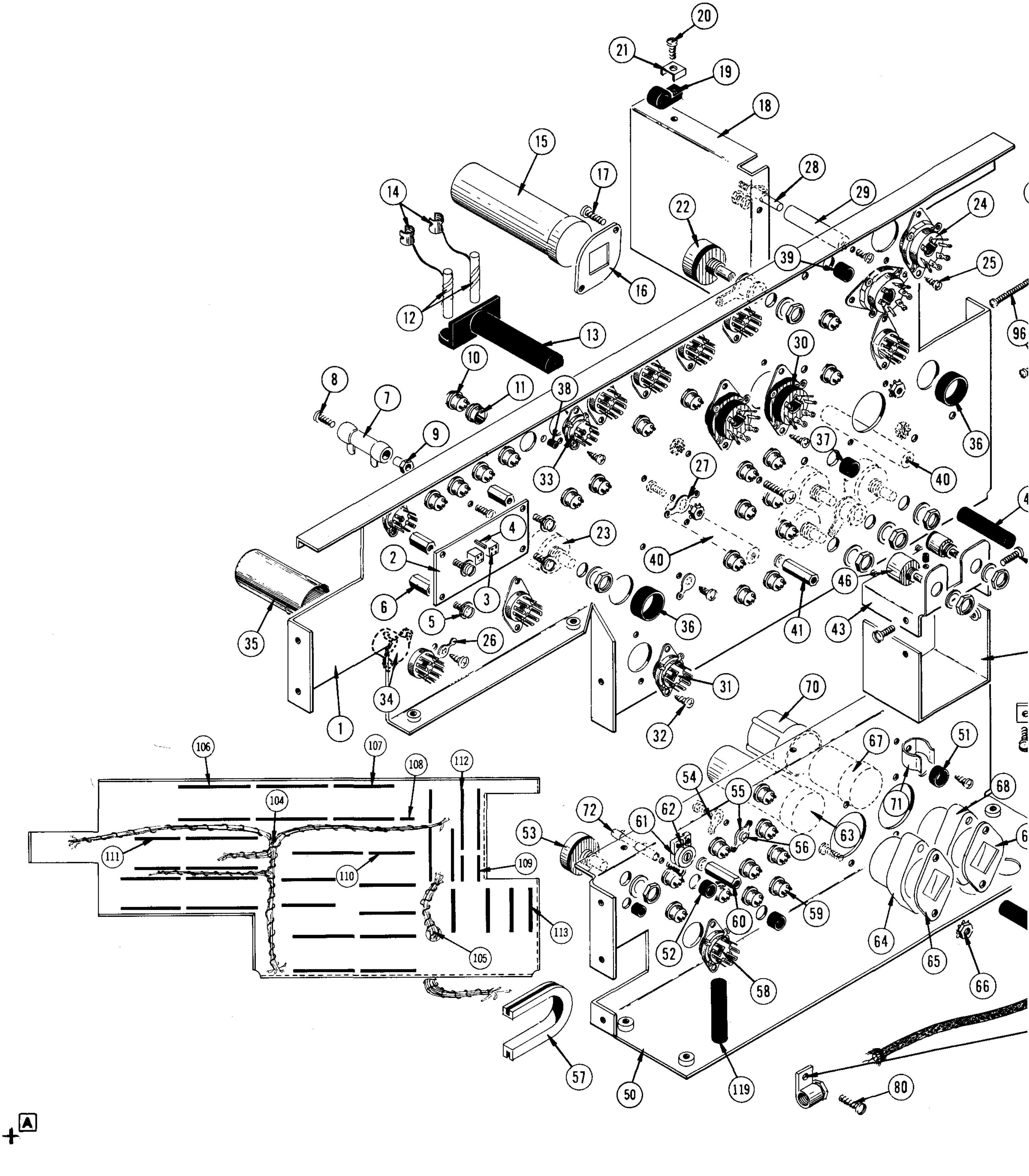
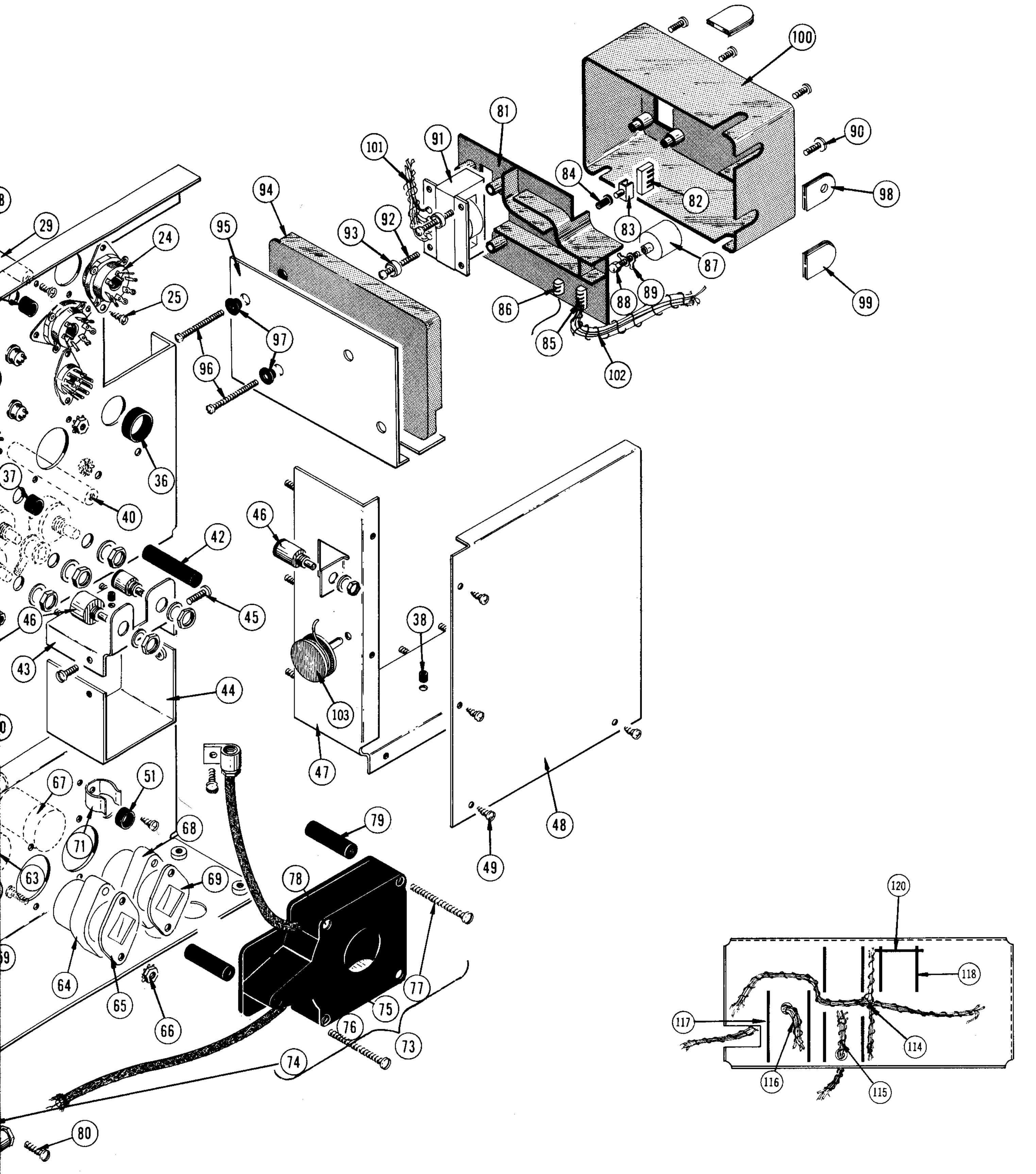
FIG. 3 "B" SWEEP, VERTICAL AMPLIFIER

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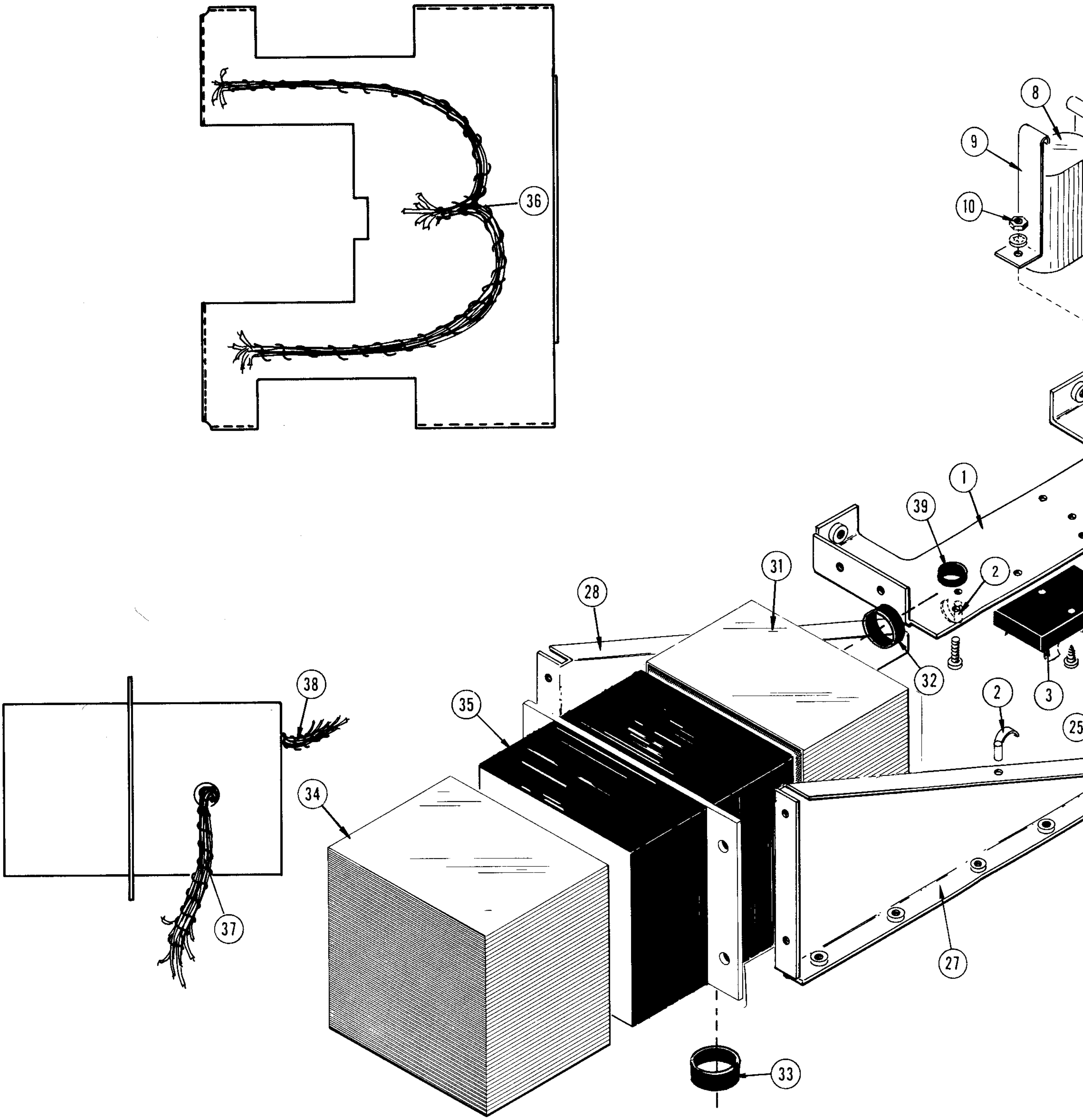

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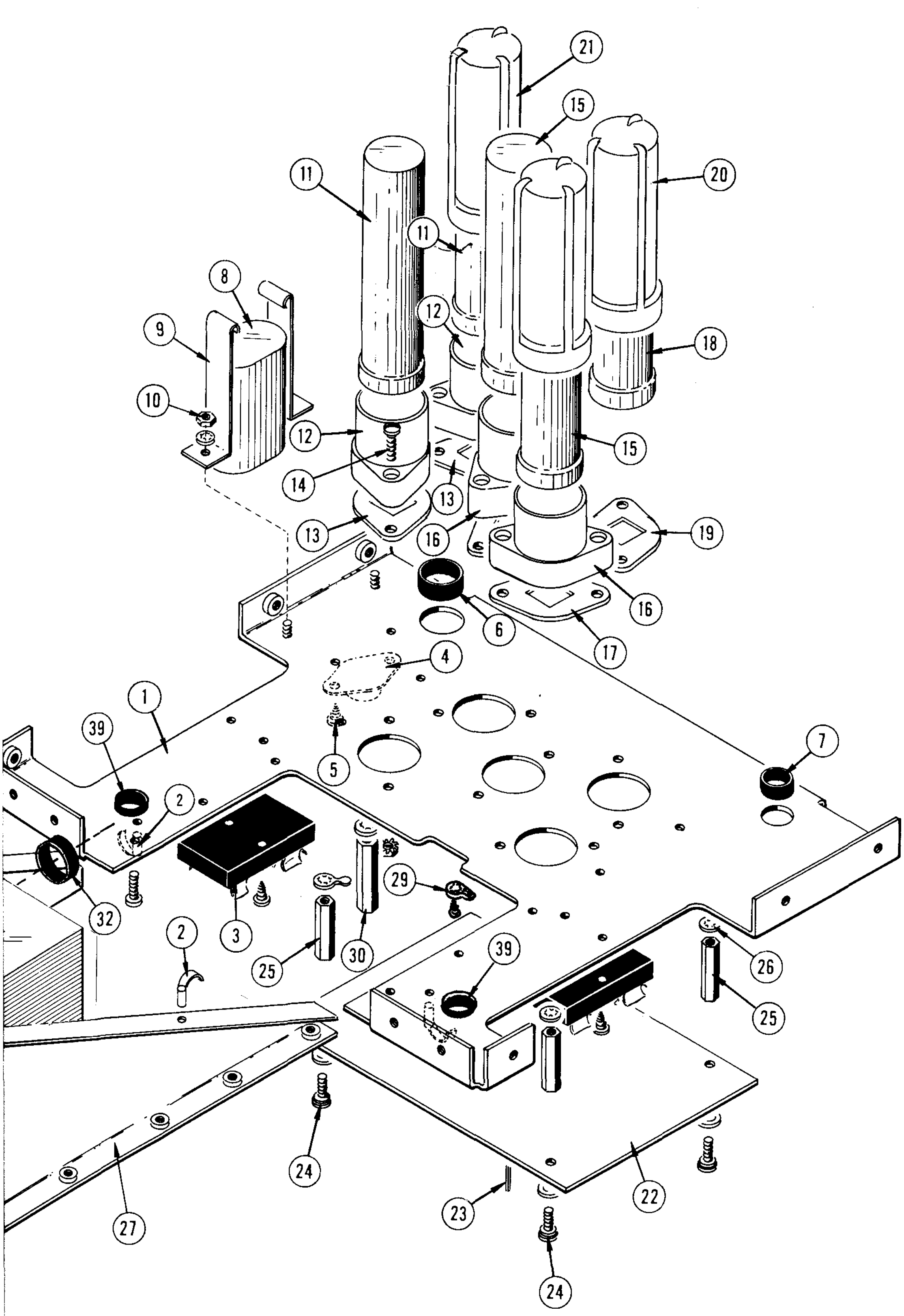
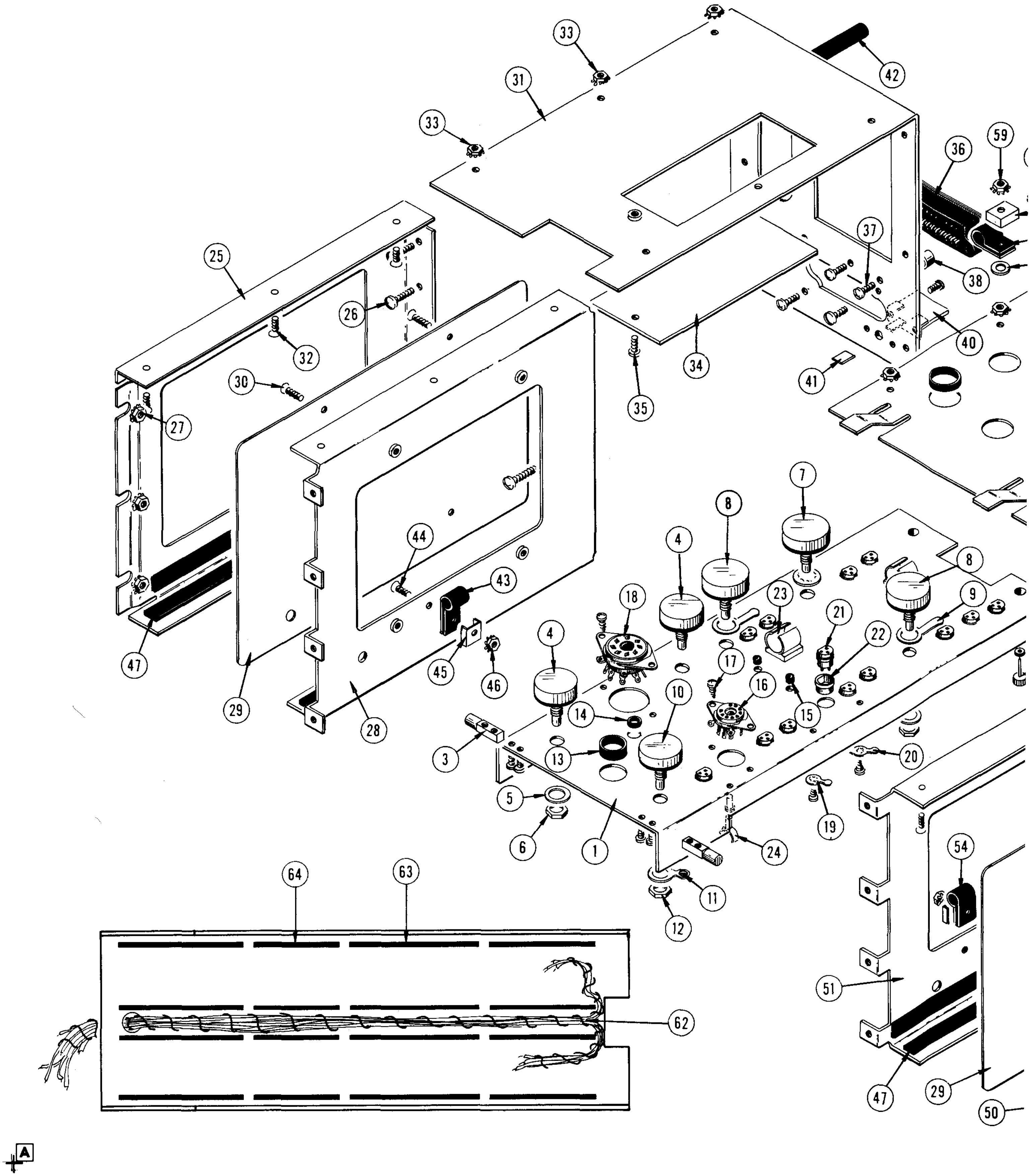
4 CAPACITOR CHASSIS & TRANSFORMER

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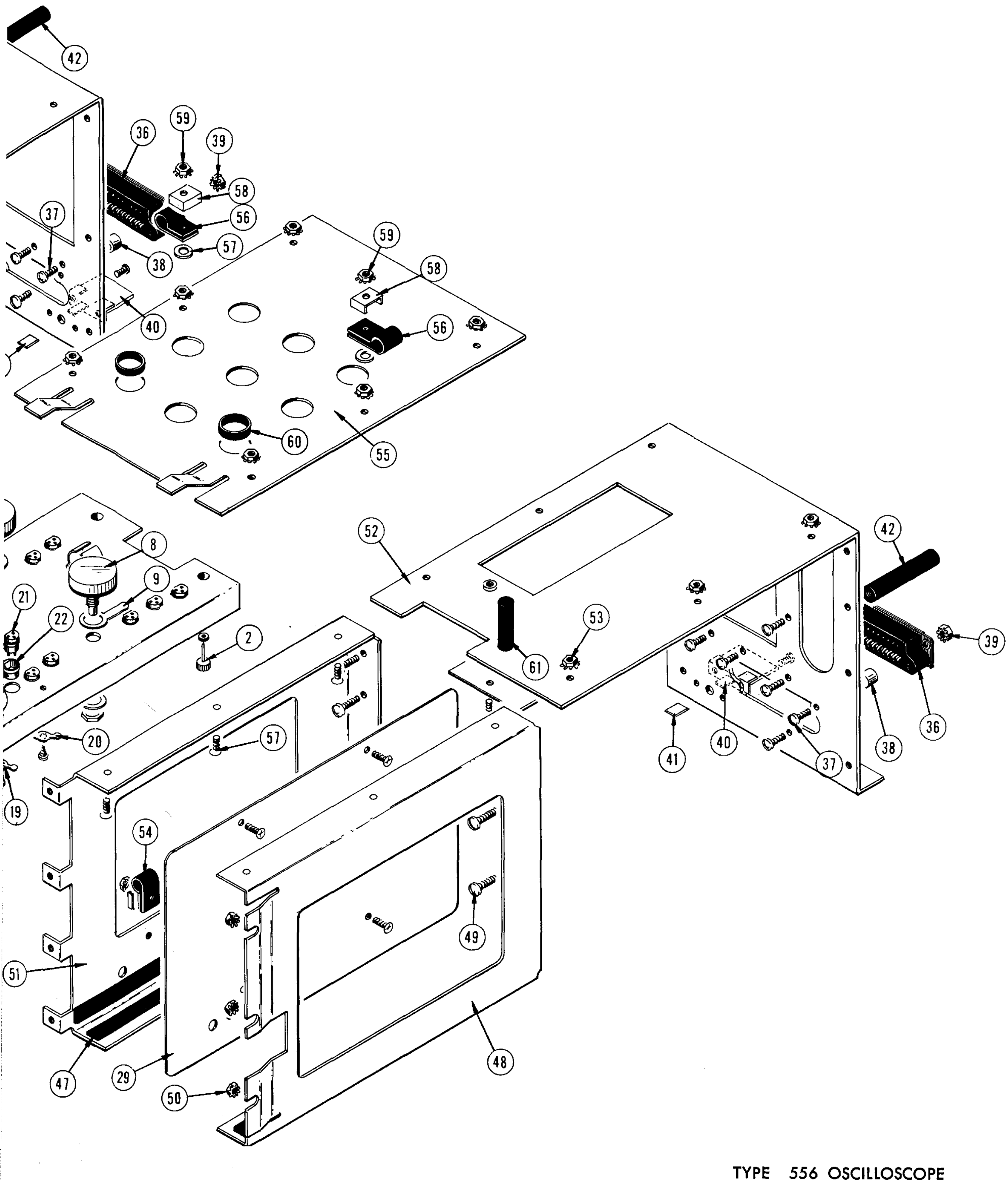
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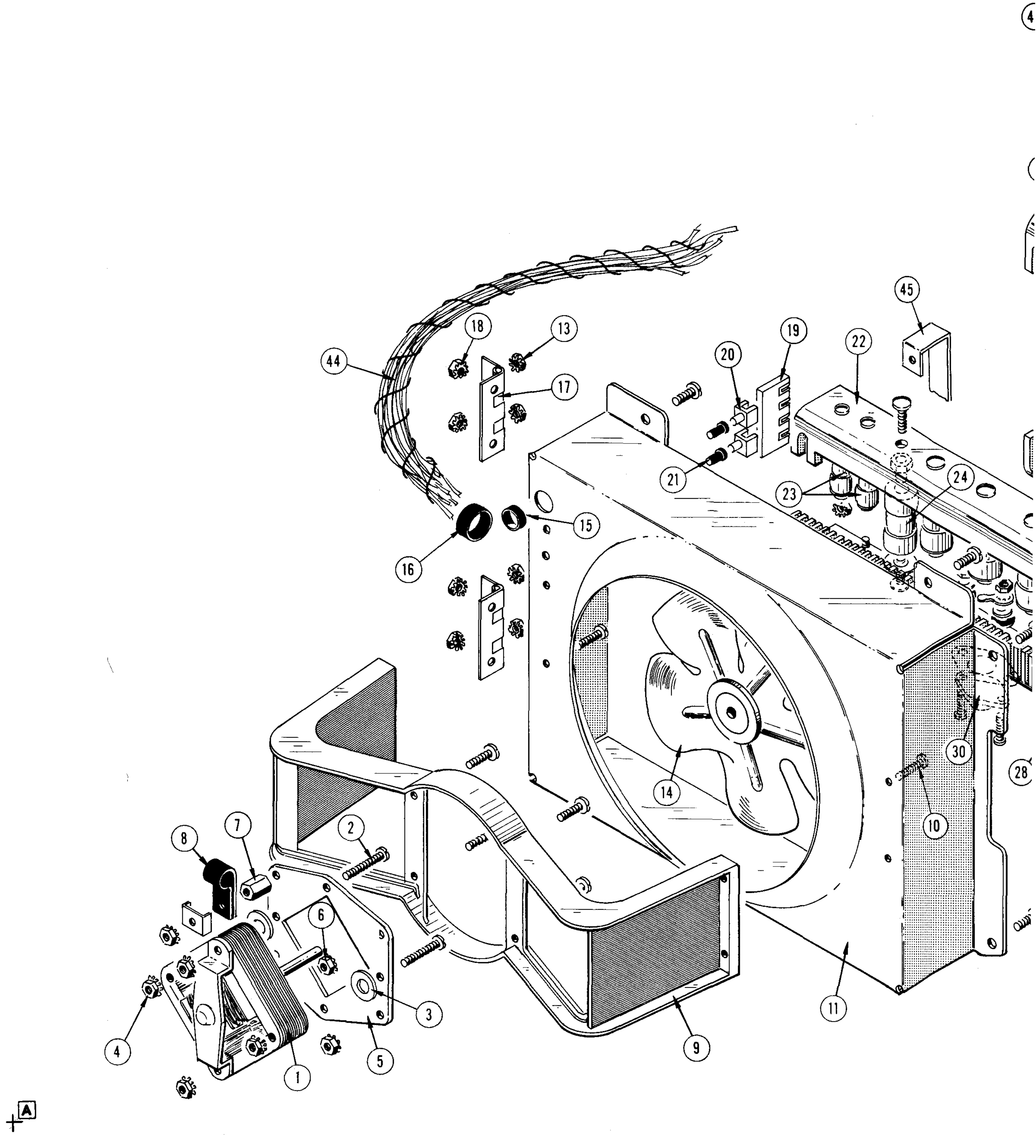
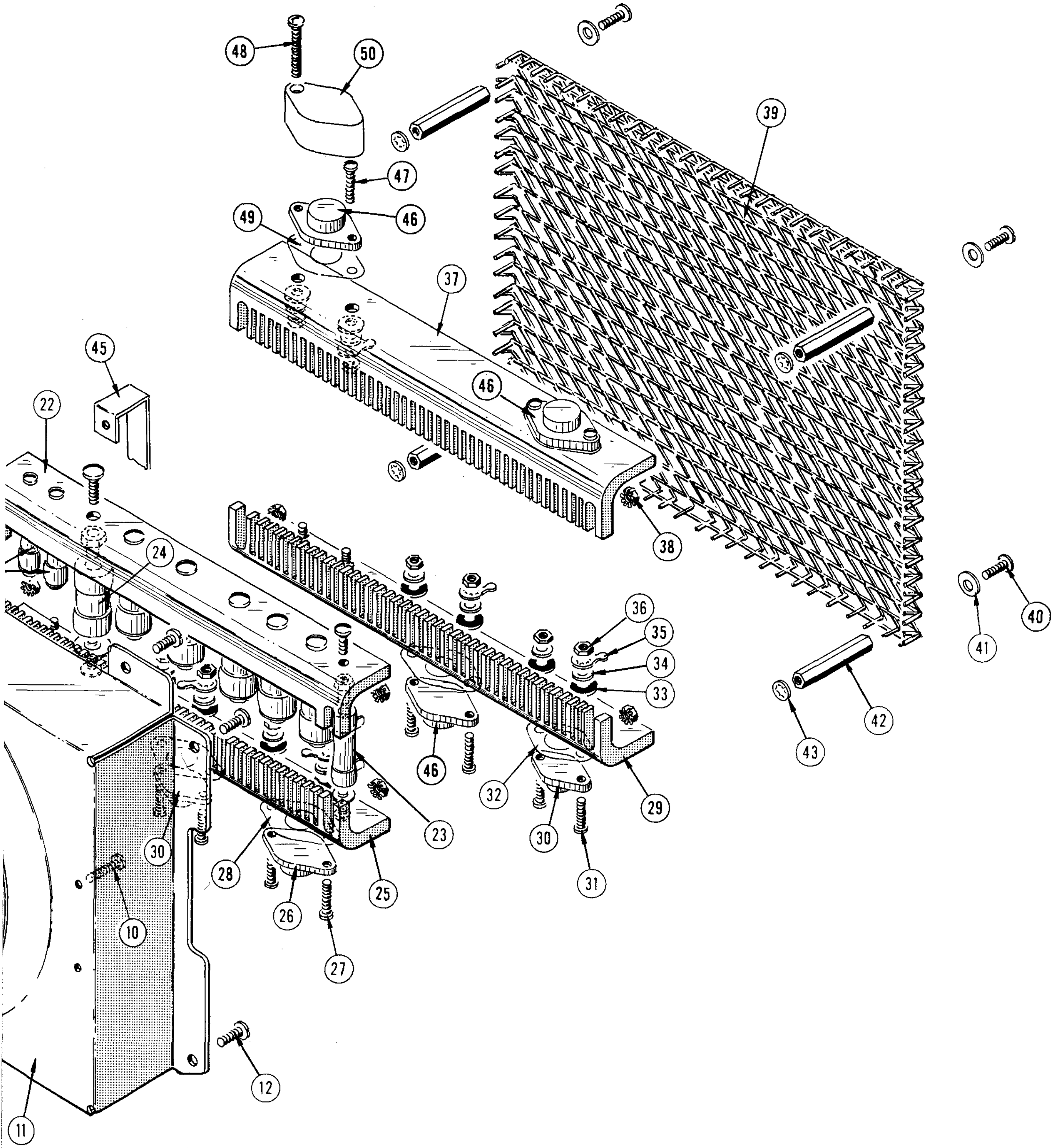
FIG. 6 FAN MOTOR & HEAT SIN



FAN MOTOR & HEAT SINK CHASSIS



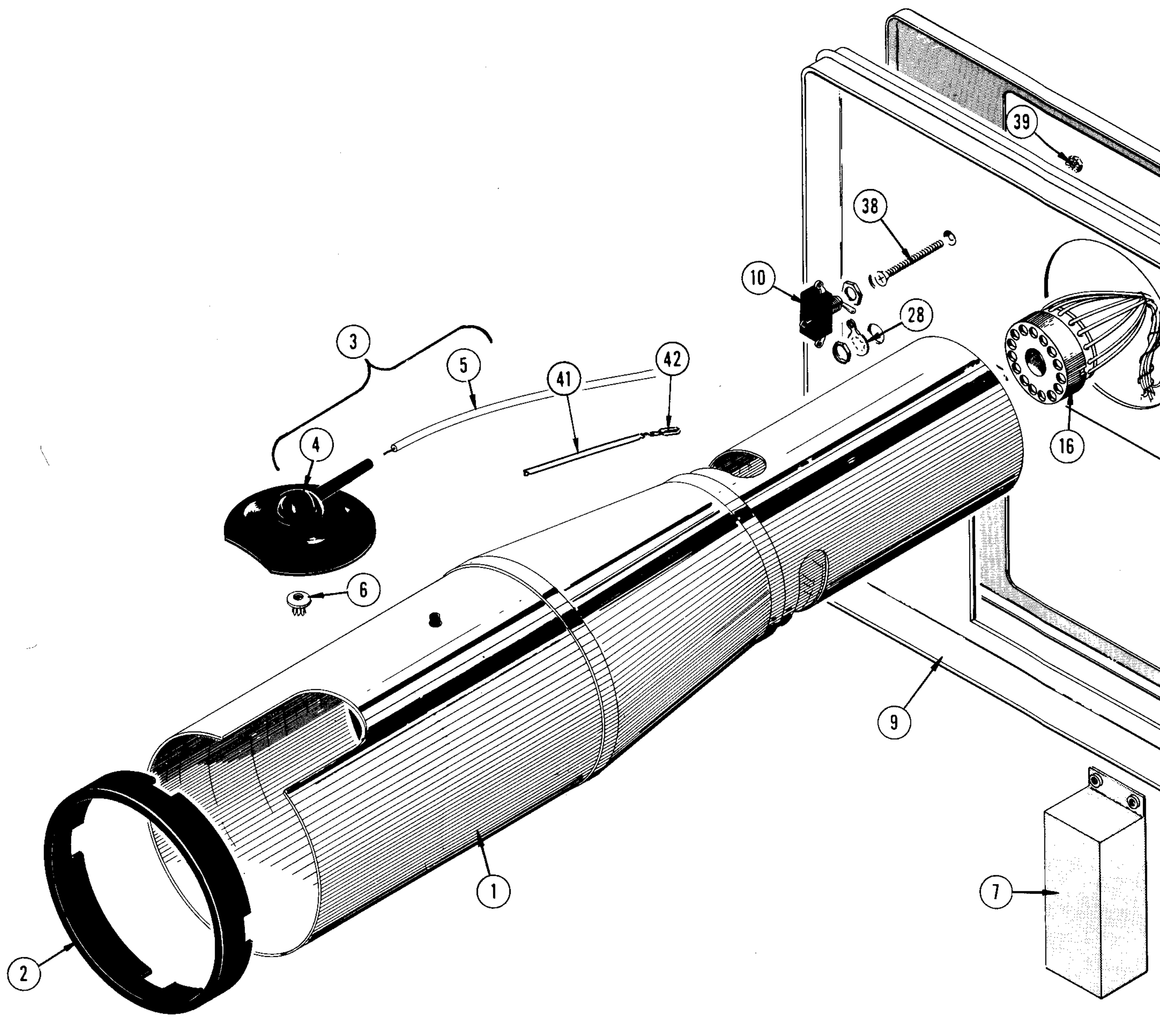

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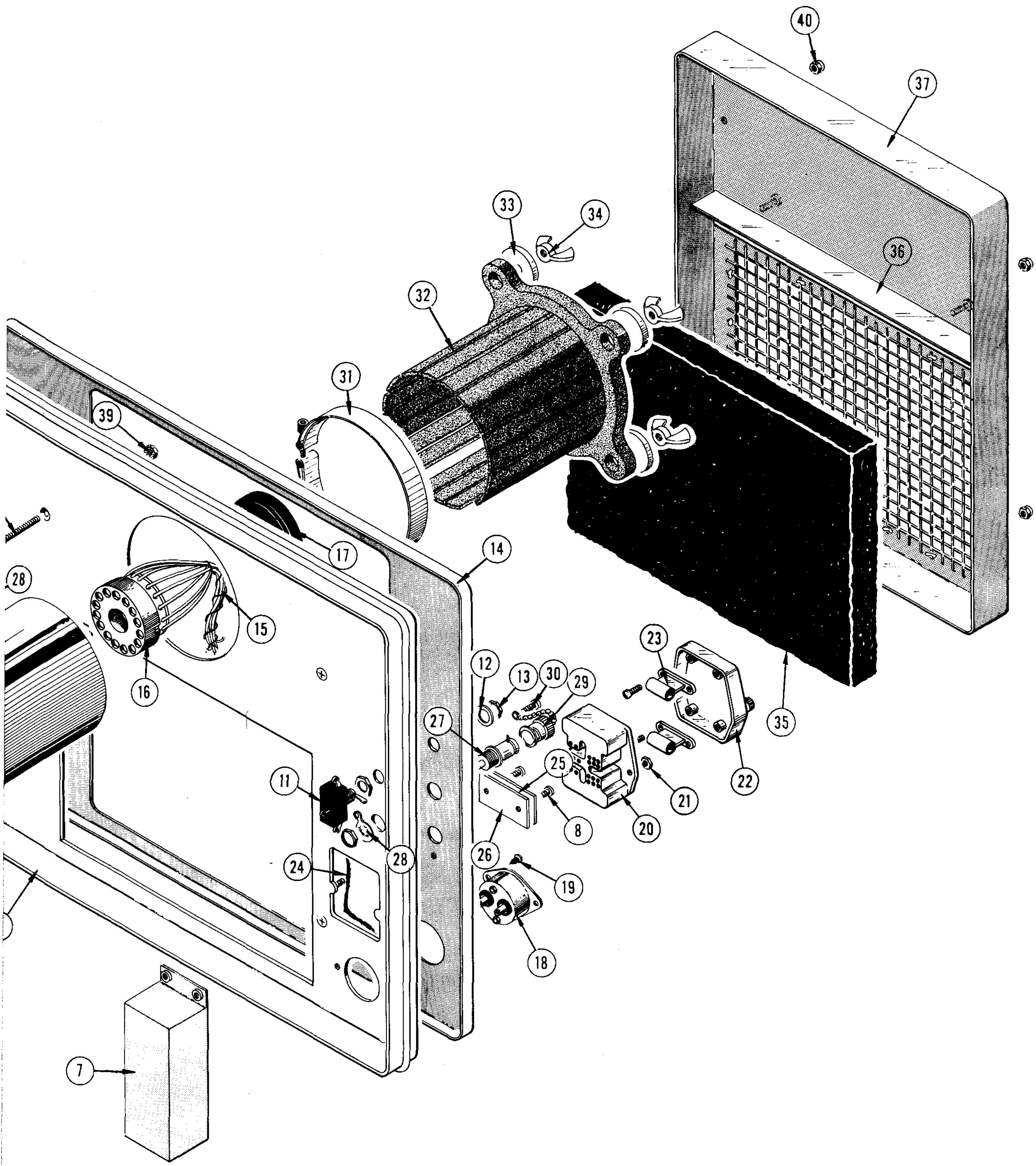
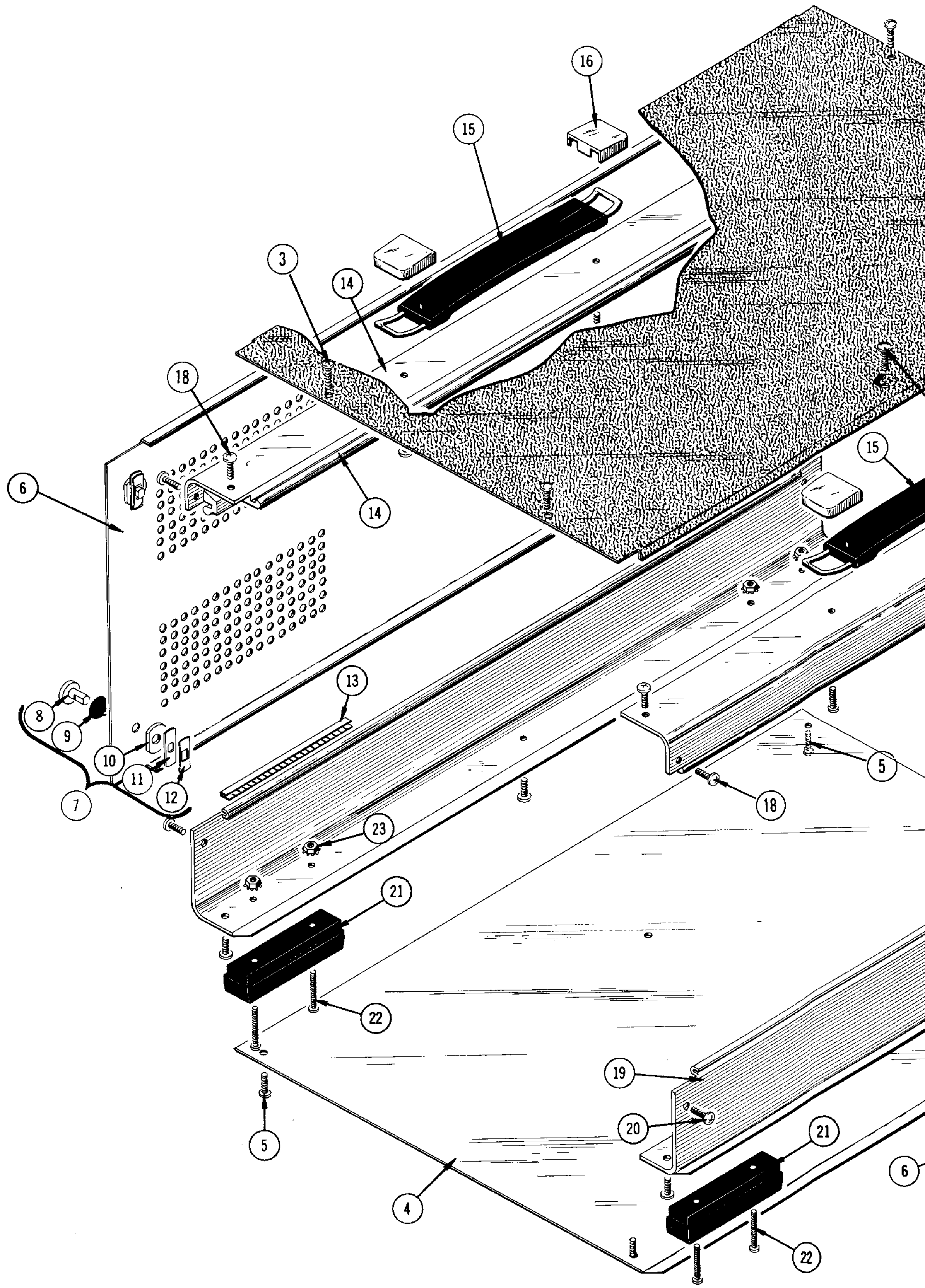
FIG. 7 CRT SHIELD & REAR





+A

FIG. 8 CABINET & RAILS

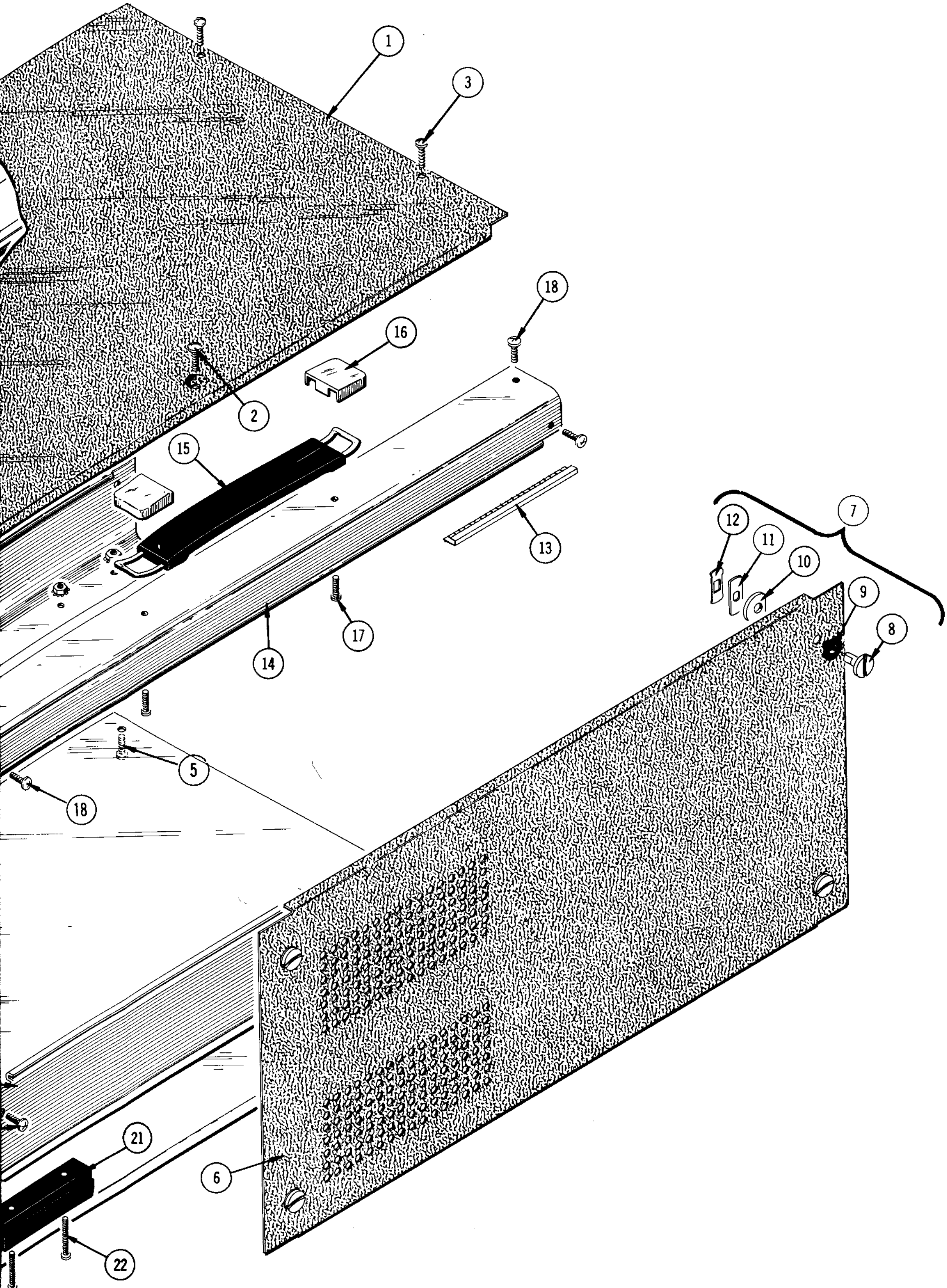
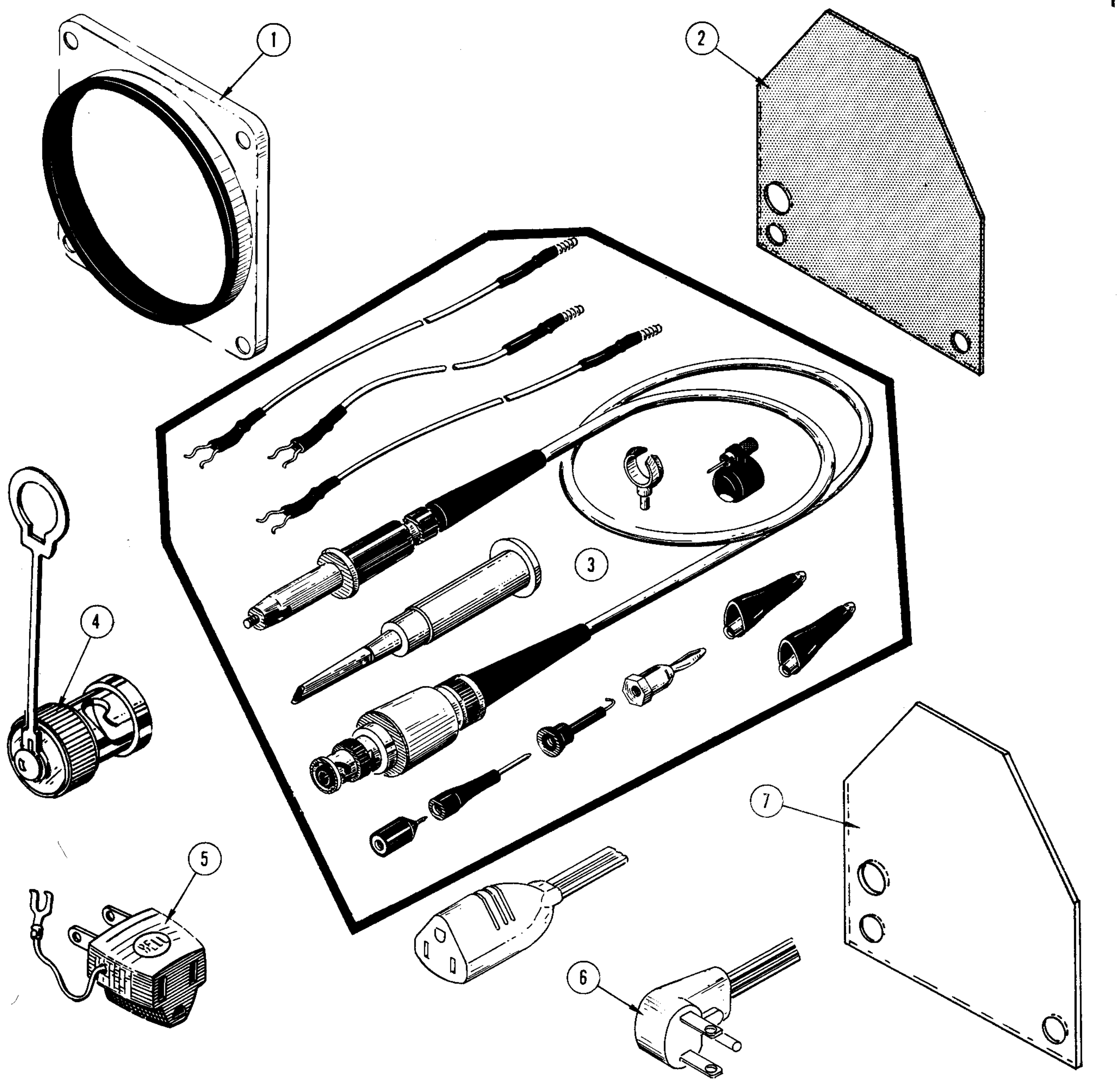


FIG. 9 STANDARD ACCESSORIES



A

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Q t y	Description 1 2 3 4 5
9-1	200-0382-00			1	COVER, graticule
-2	378-0567-00			1	FILTER, light, smokey grey
-3	010-0129-00			4	PROBE, P6008, 10 MEG, 10X BNC
-4	016-0088-00			8	COVER, BNC, non-shorting w/strap
-5	103-0013-00			1	ADAPTER, power cord, 3 wire to 2 wire
-6	161-0030-00			1	CORD, power, 3 conductor, 9 feet long
-7	387-0918-00			1	PLATE, CRT face protector
	070-0757-00			2	MANUAL, instruction (not shown)

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages. If it does not, your manual is correct as printed.

TYPE 556

PARTS LIST CORRECTION

CHANGE TO:

R559	321-0245-00	3.48 kΩ	1/8 W	Prec	1%
R561	315-0560-00	56 Ω	1/4 W		5%
R563	323-0326-00	24.3 kΩ	1/2 W	Prec	1%
R759	321-0245-00	3.48 kΩ	1/8 W	Prec	1%.
R761	315-0560-00	56 Ω	1/4 W		5%
R763	323-0326-00	24.3 kΩ	1/2 W	Prec	1%

TYPE 556 TENT SN 2090

TYPE R556 TENT SN 1050

PARTS LIST CORRECTION

CHANGE TO:

R1319	311-0415-01
R1336	311-0121-01
R1369	311-0415-01
R1386	311-0121-01

TYPE 556/R556

PARTS LIST CORRECTION

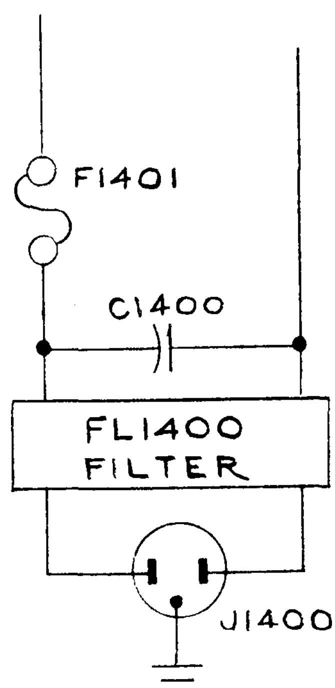
CHANGE TO:

FL1400	119-0135-03		

ADD:

C1400	285-0672-00	.1 µF	600 V

SCHEMATIC CORRECTION



PARTIAL

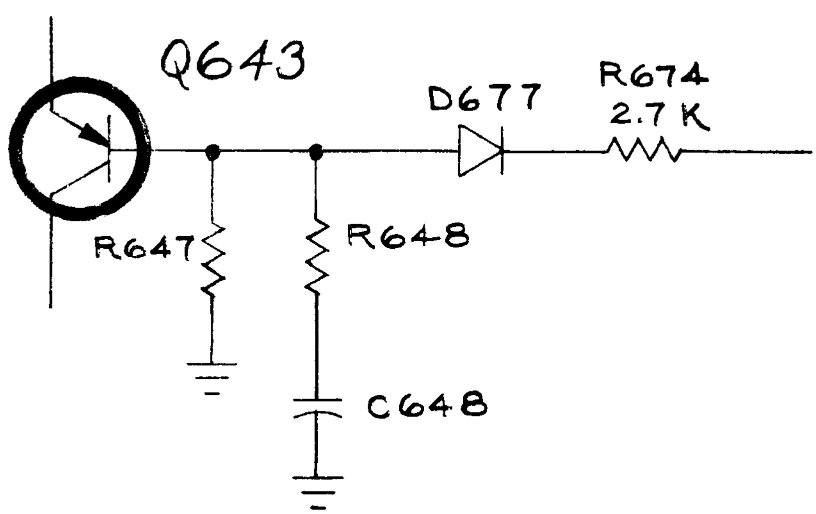
POWER SUPPLY ⟨14⟩

M12,980/967

PARTS LIST AND SCHEMATIC CORRECTION

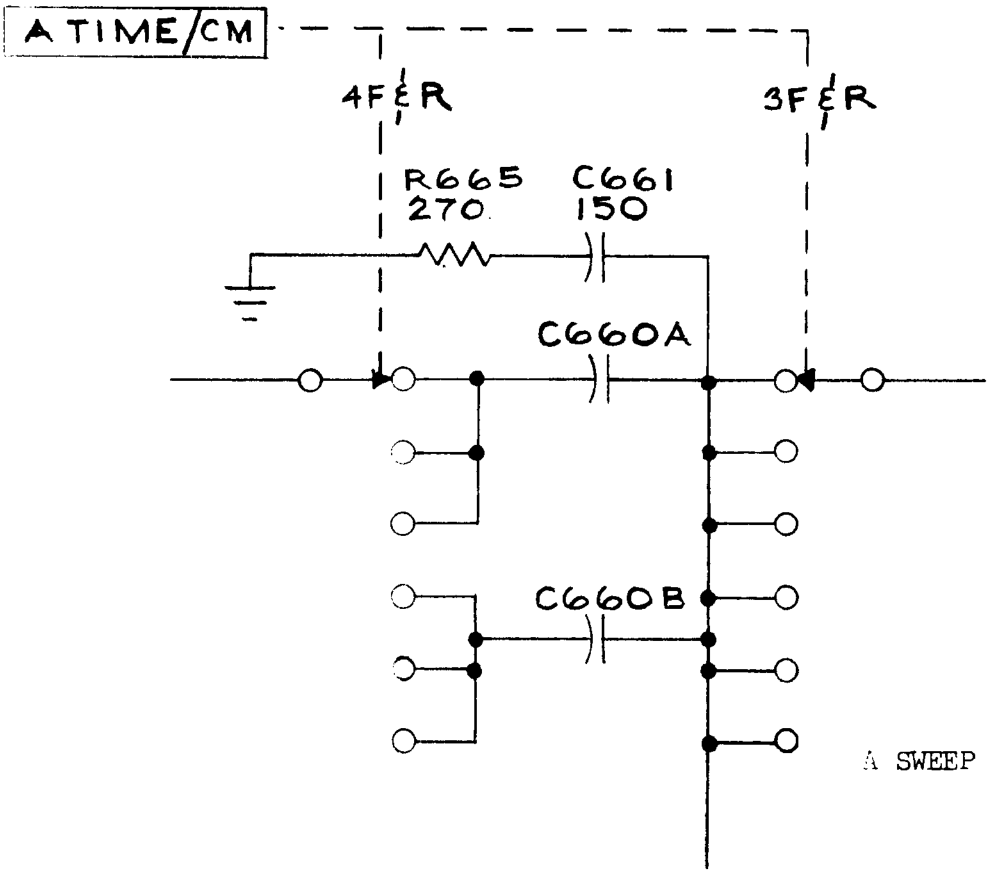
ADD:

C661	281-0524-00	150 pF	Cer	500 V	
C861	281-0524-00	150 pF	Cer	500 V	
R665	315-0271-00	270 Ω	1/4 W		5%
R674	315-0272-00	2.7 k	1/4 W		5%
R865	315-0271-00	270 Ω	1/4 W		5%
R874	315-0272-00	2.7 k	1/4 W		5%



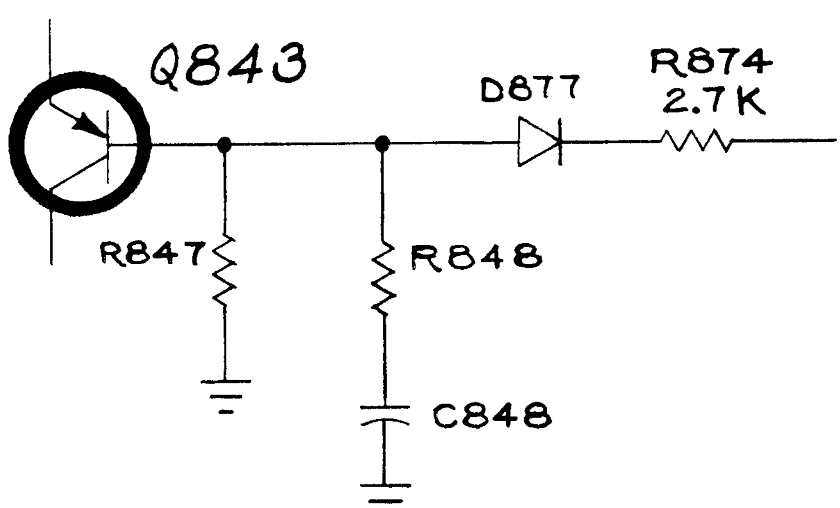
PARTIAL

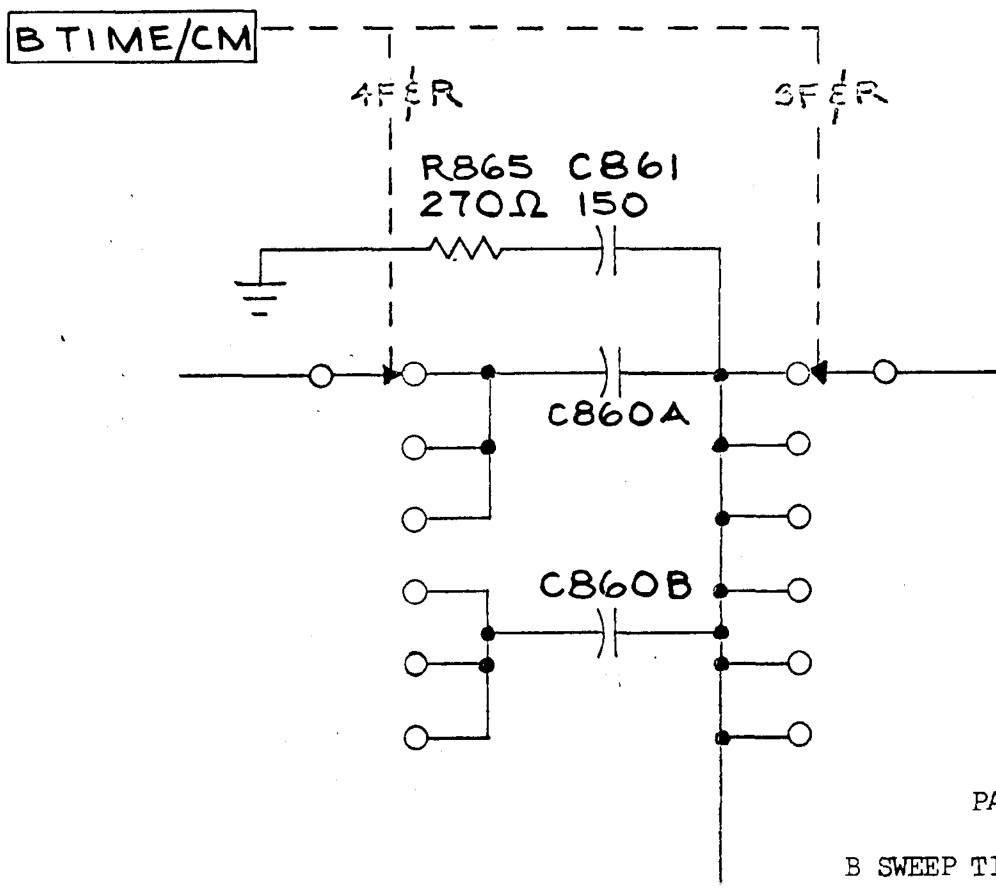
A SWEEP GENERATOR



PARTIAL
A SWEEP TIMING SWITCH

PARTIAL
B SWEEP GENERATOR





PARTIAL

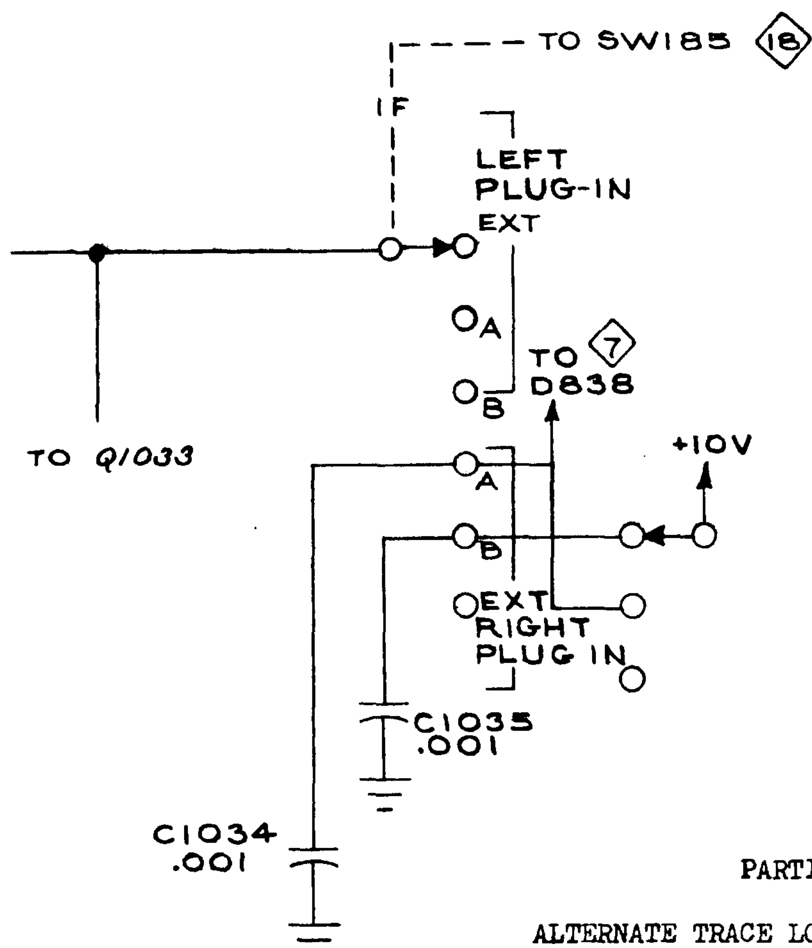
B SWEEP TIMING SWITCH

PARTS LIST CORRECTION

ADD:

C1034	283-0000-00	0.001 µF	Cer	500 V
C1035	283-0000-00	0.001 µF	Cer	500 V
R1101	315-0101-00	100 Ω	1/4 W	5%
R1201	315-0101-00	100 Ω	1/4 W	5%

SCHEMATIC CORRECTION



PARTIAL

ALTERNATE TRACE LOGIC AND BLANKING 10

ADD: C1034 and C1035 as shown above:

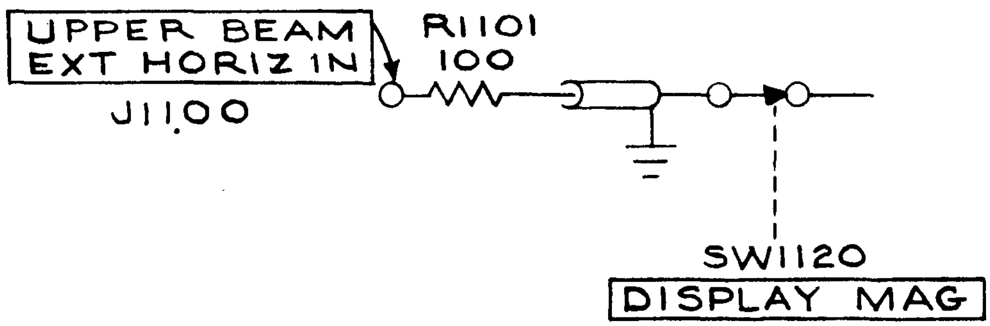
M13,361/168

TYPE 556 TENT SN 2270

SCHEMATIC CORRECTION

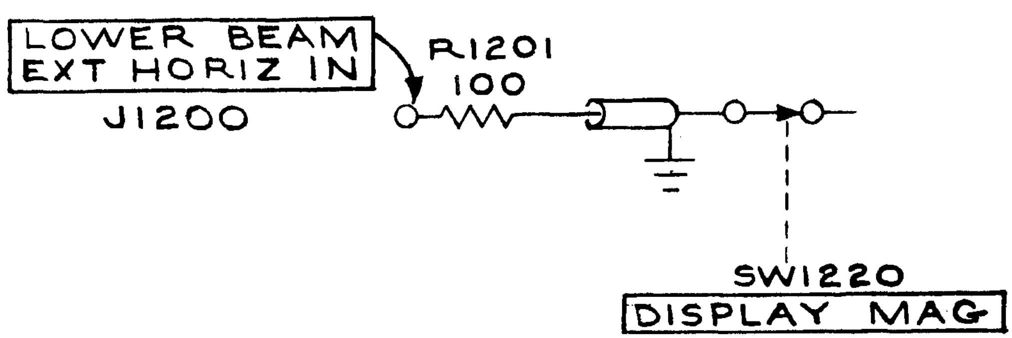
UPPER BEAM HORIZONTAL AMPLIFIER 11

ADD: R1101 as shown below:



LOWER BEAM HORIZONTAL AMPLIFIER 12

ADD: R1201 as shown below:



M13,361/168

K4XL's BAMA

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